SARASVATI

Technology

Volume 5

Curved copper knife. Finely woven cloth has been wrapped around one end, possibly to make a handle or as a cap. Harappa. [After Figs. 7.5 Kenoyer, J.M., 1998, *Ancient Cities of the Indus Valley Civilization*, OUP.]

Large updraft kiln of the Harappan period (ca. 2400 BCE) found during excavations on Mound E Harappa, 1989 (After Fig. 8.8, Kenoyer, 2000)

bharatiyo = a caster of metals; a brazier; bharatar, bharatal, bharatal. = moulded; an article made in a mould; bharata = casting metals in moulds; bharavum = to fill in; to put in; to pour into (G.lex.) **bhart** = a mixed metal of copper and lead; bhart-i_ya_ = a barzier, worker in metal; bhat., bhra_s.t.ra = oven, furnace (Skt.)

Dr. S. Kalyanaraman

Babasaheb (Umakanta Keshav) Apte Smarak Samiti

Bangalore 2003

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About the Author

Dr. S. Kalyanaraman has a Ph.D. in Public Administration from the University of the Philippines; his graduate degree from Annamalai University was in Statistics and Economics. His PhD dissertation was on development administration, a comparative study of 6 Asian countries, published as *Public Administration in Asia* in 2 volumes.

He was a Senior Executive in the Asian Development Bank, Manila, Philippines for 18 years from 1978 to 1995 responsible for the world-wide IT network of the Bank and disbursements on a portfolio of US$60 million for over 600 projects in 29 developing countries of Asia-Pacific region. Prior to joining the Bank, he was Financial Advisor on the Indian Railways (responsible, as part of a professional team, for introducing computers on the Railways) and Chief Controller of Accounts, Karnataka Electricity Board. He took voluntary retirement from the Bank five years' ahead of schedule and returned to Bharat to devote himself to Sarasvati River researches and development projects.

He is well-versed in many languages of Bharat: Tamil, Telugu, Kannada, Hindi, Sanskrit. He has compiled a comparative dictionary for 25 ancient Indian languages, titled *Indian Lexicon*. He has set up a website on Sarasvati River and Civilization with over 30,000 files (http://www.hindunet.org/saraswati); he is the founder of the yahoogroup, IndianCivilization, which has over 800 members (April 2003). His work, *Sarasvati*, was published in 2001 a compendium on the discovery of Vedic River Sarasvati. The present 7-volume enyclopaedic work on *Sarasvati Civilization* is a result of over 20 years of study and research. He is Director, Sarasvati Nadi Shodh Prakalp, Akhil Bharatiya Itihaasa Sankalana Yojana, Chennai 600015. The Prakalp is engaged in researches related to Sarasvati Civilization and interlinking of national rivers of Bharat. He has contributed to many scholarly journals and participated in and made presentations in a number of national and international conferences including the World Sanskrit Conference held in Bangalore in 1995. He delivered the Keynote address in the International Conference of World Association of Vedic Studies, 3rd Conference held in University of Massachusetts, Dartmouth, in July 2002. kalyan97@yahoo.com

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Diacritical marks used

The Kyoto-Harvard convention is NOT used since the intermingling of English words with Indian language words wll distort the representation of capital letters and is not easy to read.

The standard diacritical marks are deployed but, instead of ligaturing them on top and bottom of the alphabet, the diacritical marks FOLLOW immediately after the vowel or consonant which is modified. For e.g., a_ connotes ‘long a’, n. connotes retroflex N. After the UNICODE is standardized, the next edition will display the modified codes for ease of representation on web pages on the internet.

a r*u*t,*a*t a_/ l*aw* a~_ l*ong* /a~ *un-* *i it* i_ b*ee* i~_ b*een* /i~ *in* u y*ou* u_/ *oo*ze u~_ b*oon* /u~ j*un*e …	e b*e*t e_ *a*te e~_ b*an*e /e~ wh*en*,*whey* o *o*bese o_ n*o*te o~_ b*one*,*one* m. mu*m* n: ki*ng* *n~* *ny*et h-/k- w*h*at c *ch*ange c. *s*o	d *th*en d. *d*ot l. riva*lr*y n. a*n*d n- *n*ew r- cu*rl* r. *r*ug r.. (*zsh*) s fu*s*e s. *sh*ut s' *s*ugar t bo*th* t. *t*oo

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List of languages and abbreviations

The languages of the linguistic area and the abbreviations used are as follows:

A.Assamese
Ap.Apabhram.s'a
Ash. Ashkun (As.ku~_--Kafiri)
Aw. Awadhi_
B. Bengali (Ban:gla_)
Bal. Balu_ci_ (Iranian)
Bashg. Bashgali_ (Kafiri)
BCE Before Common Era (BC)
Bel. Belari
Bhoj. Bhojpuri_
Bi. Biha_ri_
Br. Bra_hui_
Brj. Brajbha_s.a_
Bshk. Bashkari_k (Dardic)
Bur.Burushaski
CE Common Era (AD)
Chil. Chili_s (Dardic)
D.. D.uma_ki
Dm. Dame~d.i_ (Kafiri-Dardic)
G. Gujara_ti_
Ga. Gadba
Garh.Gar.hwa_li_
Gau. Gauro (Dardic)
Gaw.Gawar-Bati (Dardic)
Gmb. Gambi_ri_ (Kafiri)
Go. Gondi
Gy. Gypsy or Romani
H. Hindi_
Ir. Irul.a
K. Ka_s'mi_ri_
Ka. Kannad.a
Kaf. Kafiri
Kal. Kalasha (Dardic)
Kand. Kandia (Dardic)
Kat.. Kat.a_rqala_ (Dardic)
Kho. Khowa_r (Dardic)
Khot. Khotanese (Iranian)
Kmd. Ka_mdeshi (Kafiri)
Ko. Kota
Kod.. Kod.agu (Coorg)
Koh. Kohista_ni_ (Dardic)
Kol. Kolami
Kon. Kon:kan.i_
Kond.a
Kor. Koraga
Kt. Kati or Katei (Kafiri)
Ku. Kumauni_
Kui
Kurub.Bet.t.a Kuruba
Kur.Kur.ux (Oraon, Kuru*kh*)
Kuwi
L. Lahnda_
M. Mara_t.hi_
Ma.Malayalam
Mai.Maiya~_ (Dardic)
Malt.Malto
Ma_lw.Ma_lwa_i_
Mand.. Mand.a
Marw.Ma_rwa_r.i_
Md.Maldivian dialect of Sinhalese
MIA Middle Indo-Aryan
Mj. Munji_ (Iranian)
Mth. Maithili_
Mu. Mun.d.a_ri (Munda)
N. Nepa_li
Nahali
Nin:g. Nin:gala_mi (Dardic)
Nk. Naikr.i (dialect of Kolami = LSI, Bhili of Basim; Naiki of Chanda)
OIA Old Indo-Aryan
Or. Or.iya_
P. Punja_bi_ (Paja_bi_)
Pa. Parji
Pali
Pah. Paha_r.i_
Pa_Ku. Pa_lu Kur-umba
Pas'. Pas'ai (Dardic)
Pe. Pengo
Phal. Phalu_r.a (Dardic)
Pkt. Prakrit
S. Sindhi_
Sant. Santa_li_ (Mun.d.a_)
Sh. Shina (S.in.a_.Dardic)
Si. Sinhalese
Sik. Sikalga_ri_ (Mixed Gypsy Language: LSI xi 167)
Skt. Sanskrit
Sv. Savi (Dardic)
Ta.Tamil
Te.Telugu
Tir.Tira_hi_ (Dardic)
To. Toda
Tor.To_rwa_li_ (Dardic)
Tu. Tulu
U. Urdu
Werch.Werchikwa_r or Wershikwa_r (Yasin dialect of Burushaski)
Wg. Waigali_ or Wai-ala_ (Kafiri)
Wkh. Wakhi (Iranian)
Wot..Wot.apu_ri_ (language of Wot.apu_r and Kat.a_rqala_. Dardic)
WPah. West Paha_r.i

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Abbreviations used for linguistic categories and other languages

Languages, Epigraphs

As'. As'okan inscriptions
Austro-as. Austro-asiatic (cf. Munda)
BHSkt. Buddhist Hybrid Sanskrit (Franklin Edgerton, Buddhist Hybrid Sanskrit Grammar and Dictionary, Newhaven, 1953)
Dard. Dardic
Dhp. Ga_ndha_ri or Northwest Prakrit (as recorded in the Dharmapada ed. J. Brough, Oxford 1962)
Drav. Dravidian
IA. Indo-aryan
IE. Indo-european
Ind. Indo-aryan of India proper excluding Kafiri and Dardic (as classified by R.L. Turner)
KharI. Kharos.t.hi_ inscriptions; Middle Indo-aryan forms occurring in Corpus Inscriptionum Indicarum Vol. II Pt.I, Calcutta, 1929 MIA Middle Indo-aryan
NiDoc. Language of 'Kharos.t.hi_ Inscriptions discovered by Sir Aurel Stein in Chinese Turkestan' edited by A.M. Boyer, E.J. Rapson, and E. Senart
Ar.Arabic
Aram.Aramaic
Arm.Armenian
Av. Avestan (Iranian)
E. English
Gk. Greek
Goth. Gothic
Ishk. Ishka_shmi_ (Iranian)
Kurd. Kurdish (Iranian)
Lat. Latin
Lith.Lithuanian
OHG. Old High German
Orm. O_rmur.i_ (Iranian)
OSlav. Old Slavonic

etym. etymology
expr.expression
f./fem. feminine
fig. figuratively
fr. from
fut. future
gen. genitive
hon. honorific
id. idem (having the same meaning)
imper.imperative
incl. including
inf.infinitive
inj.injunctive
inscr.inscription
lex. lexicographical works or Kos'as
lit. literature
loc. locative
m. masculine
M Middle
metath. metathesis (of)
N North
Na_ Na_ci Na_t.u usage
Naut. Nautical
nom.nominative
nom.prop. nomen proprium (proper name)
num.numeral(s)
NWNorth-west
O Old
obl. oblique case
onom.onomatopoeic
p. page
part. participle
pass. passive
perf. perfect
perh. perhaps
phonet.phonetically
pl. plural
pp. past participle (passive)
pres. present
pron. pronoun

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Par. Para_ci_ (Iranian)
Pahl. Pahlavi (Iranian)
Pers. Persian (Iranian)
Port. Portuguese
Pr. Prasun (Kafiri)
Psht. Pashto (Iranian)
Tib. Tibetan
Toch. Tocharian
Turk. Turkish
Yid. Yidgha (Iranian)

Abbreviations : Grammatical

* hypothetical
< (is) derived from
> (has) become
? doubtful
Xinfluenced by
+ extended by
~ parallel with
acc.accusative
adj. adjective
adv. adverb
aor. aorist
caus. causative
cent. century
cf. confer (compare)
cmpd.compound(ed)
com. commentary, t.i_ka_
conj.conjunction
dat. dative
dist.fr.distinct from
du. dual
E East
e.g. example

Pudu. Pudukkottai usage
redup. reduplicated
ref. reference(s)
S South
sb./subst.substantive
semant. semantically
st. stem
subj. subjunctive
syn. synonym
Tinn. Tinnevelly usage
Tj. Tanjore usage
usu. usual(ly)
vais.n..vais.n.ava usage
vb. verb
viz. videlicet (namely)
W West

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Foreword

I had written a foreword for Dr. Kalyanaraman's work titled *Sarasvati* in 2000. As promised, he has now followed up this work with an additional seven volumes to complete the encyclopaedia on Sarasvati – the river, godess and civilization of Bha_rata.

It is a privilege indeed to receive the seven volumes titled:

Sarasvati: Civilization
Sarasvati: R.gveda
Sarasvati: River
Sarasvati: Bharati
Sarasvati: Technology
Sarasvati: Language
Sarasvati: Epigraphs

This septet constitutes a fitting homage to Babasaheb (Uma_ka_nt kes'av) Apte, particularly in the wake of the centenary celebrations planned for 2003 in memory of this patriot who wanted a presentation of the history of Bha_rata from a Bha_rati_ya socio-cultural perspective.

The dream of the late Padmashri Vakankar, archaeologist is also partly fulfilled with the delineation of the peoples' lives over 5,000 years on the banks of the Rivers Sarasvati and Sindhu.

The Sarasvati Nadi Shodh Prakalp which is headed by Dr. Kalyanaraman under the guidance of Shri Haribhau Vaze, All-India Organizing Secretary, Akhila Bharateeya Itihaasa Sankalana Yojana should be complimented for bringing to successful completion this important phase of writing of the history of ancient Bha_rata.

The River Sarasvati has not only been established as ground-truth (bhu_mi satyam), but the vibrant civilization which was nurtured on the banks of this river has been exquisitely unraveled in the five volumes, covering virtually all aspects of the lives of the pitr.-s, many of whose a_s'rama-s are venerated even today in many parts of Bha_rata.

The seven volumes provide a framework for understanding the writing system evolved ca. 5,300 years ago to record the possessions and items traded by metal- and fire-workers, the bharata-s. The language spoken by the people is also becoming clearer, with the existence of a linguistic area on the banks of the two rivers – the substrata and ad-strata lexemes which seem to match the glyphs of inscribed objects are a testimony

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to this discovery. This calls for a paradigm shift in the study of languages of Bha_rata with particular reference to the essential semantic unity of all the language families, thanks to intense socio-economic and cultural interactions across the length and breadth of Bha_rata.

Hopefully, this work should generate many more research studies of this kind to further study the impact of the civilization on the cultural unity of the nation.

It is also heartening to note that work has started to revive the Rivr Sarasvati and to interlink the rivers of the country. This will be a garland presented by the children of the country to Bha_rata Ma_ta_ setting up a network of about 40,000 kms. Of National Waterways which will complement the Railways system to further strengthen the infrastructure facilities and to provide a fillip to development projects in all sectors of the economy.

I understand that Kalyanaraman is now embarking on a project to write the history of Dharma. I wish him all success in his endeavours.

M.N. Pingley

Kaliyugabda 5105. a_s.a_d.ha, Gurupurnima. July 13, 2003 CE
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Publisher's Note

On behalf of Baba Saheb (Umakanta Keshav) Apte Smarak Samiti, it gives me great pleasure to publish the set of seven volumes of the encyclopaedic work of Dr. S. Kalyanaraman with over 4,000 illustrations and impressive documentation.

Sarasvati: Civilization
Sarasvati: R.gveda
Sarasvati: River
Sarasvati: Bharati
Sarasvati: Technology
Sarasvati: Language
Sarasvati: Epigraphs

This is a follow-up of the first work titled *Sarasvati* published in 2000 which focused on the River Sarasvati. These seven additional volumes focus on the language, writing system, technology – archaeo-metallurgy, in particular, the lives of the people who lived between 3500 to 5300 years ago and the importance of this legacy and heritage on the history of Bha_rata.

This compendium has been made possible by the contributions made by scientists and scholars of the country from a variety of disciplines, ranging from geology and glaciology to atomic research and language studies. This comprehensive work on Sarasvati thus constitutes a golden chapter in the work of the Akhila Bharateeya Itihaasa Sankalana Yojana, providing the foundation for future works on subsequent periods of the history of the nation.

A principal objective of the Baba Saheb (Umakanta Keshav) Apte Smarak Samiti is the authenticated study of the history of our nation. For this purpose the Akhila Bharatiya Itihaasa Sankalana Yojana affiliated with the Samiti, has been working with a number of scholars and institutions organizing seminars and conferences and bringing out publications. The Samiti is a non-profit, voluntary organization and is entirely supported by volunteers and philanthropists. I wish to thank all the well-wishers and contributors to the Samiti's work. In particular, I would like to acknowledge with gratitude the contribution made by Shri G. Pulla Reddy, Shri Ramadas Kamath, and Basudeo Ramsisaria Charitable Trust, ICICI, Government of Goa, in enabling this publication. Sincere thanks are due to K. Joshi and Co., and Dr. C.N. Parchure who have undertaken the supervision of the publication.

Plans have been initiated to start a national center to study the history of vanava_si people, to produce an encyclopaedia on the Hindu World and to organize research centers in all states of the country, to publish a series of research volumes on various aspects of the Bharatiya itiha_sa in all languages of Bharat, using multimedia presentations.

Haribhau Vaze
National Organizing Secretary, Akhil Bharatiya Itihaasa Sankalana Yojana and Trustee, Baba Saheb (Umakanta Keshav) Apte Smarak Samiti, Bangalore.
Kaliyugabda 5105. a_s.a_d.ha, Gurupurnima. July 13, 2003 CE

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Author’s Preface

At the outset, I offer my sincere thanks to Moropant Pingley and Haribhau Vaze for their encouragement and support in pursuing this endeavour.

What can I say which has not already been said by eminent scientists, scholars and thinkers of this great nation? All that I can do is to compile their thoughts and present them as I see fit and as a tribute to the memories of our pitr.-s and ma_tr.-s, our ancestors who have made us what we are and who have given us the *vira_sat* (heritage).

The septet contains the following volumes:

Sarasvati: Civilization
Sarasvati: R.gveda
Sarasvati: River
Sarasvati: Bharati
Sarasvati: Technology
Sarasvati: Language
Sarasvati: Epigraphs

The enduring nature of the culture of the nation has been a source of awe and inspiration for many generations of scholars.

The lives of the r.s.i-s and muni-s who contributed to the solidity of the Bha_rata Ra_s.t.ra is a source of inspiration for generations of students of philosophy, politics, sociology, spiritual studies, economics and culture.

The earlier work, *Sarasvati*, published in 2000 focused on the life-history of River Sarasvati. This set of seven volumes follow-up on this work to present a comprehensive survey of the lives of the people who nurtured a vibrant civilization on the banks of River Sarasvati. They were enterprising people who ventured to the banks of River Sindhu and beyond and had established a network of interactions which extended as far as Mesopotamia in the west and Caspian Sea in the north-west.

The River Sarasvati, flowing over 1,600 kms. from Mt. Kailas (Ma_nasarovar glacier) and tributaries emanating from Har-ki-dun (Svarga_rohin.i or Bandarpunch massifs, Western Garhwal, Uttaranchal), through Kashmir, Uttaranchal, Himachal Pradesh, Punjab, Haryana, Rajasthan, and Gujarat made the region lush with vegetation and provided a highway for interactions extending through the Gulf of Kutch, Gulf of Khambat, the Persian and Arabian Gulfs. The story of this riverine, maritime civilization is the story of an enterprising group of people who were wonderstruck by

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the bounties of nature and had organized themselves into a cooperating society to harness the bounties of nature. The Samudra manthanam imagery wherein the asura-s and deva-s cooperate in churning the ocean for its riches is an allegory of this quest for material well-being while strengthening societal bonds.

This march of history is a saga of adventure, a passion for discovery of new materials and new methods of communication using a writing system and communicating orally profound thoughts on the cosmic order in relation to humanity.

he next stop is Dharma: a history of Bharatiya Ethos and Thought.

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Table of contents

Metallurgy Tradition	14
Natural Resource map of ancient Bharat	67
Tin from Meluhha	80
Ancient Trade in Tin	91
Copper Hoard Weapons: autochthonous evolution and links with Sarasvati civilization	93
The cultural markers of legacy of the civilization	104
Words for Copper	117
Map of central Asia during Bronze Age	130
Tradition of Sacred weapons	131
Bronze age artifacts in areas neighbouring Sarasvati Civilization	205
Bharat, Hurrian, Mitanni	213
Harappan spoked wheel	240
Map of the kingdom of Mitanni	258
Index	269
End Notes	276

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Metallurgy tradition

History of Metallurgy tradition in Bharat

Evolution of technology in Bharat finds early expression in the cutting of sea shells (**s'ankha** or *turbinella pyrum*) to create bangles and ornaments. It is also seen in the skills achieved in creating water reservoirs cut out of rocks (as in Dholavira) and architectural accomplishments of creating drains, water tanks with steps and buildings made of shaped stones (including use of polished pillars and ring-stones as structural supports). These developments were made possible by the invention of alloys called bronze, brass, bell-metal and pan~caloha (alloy of 5 metals) which were used for making tools, weapons and also household utensils.

R.gveda is replete with allegorical and direct references to metallurgical activities, exemplified by the metaphor of the ratha to denote cyclical time and related astronomical observations.

Metallurgical tradition of Bharat is highlighted by the iron pillar in Delhi which has stood the ravages of time and shining still after nearly 1,500 years.

The search for minerals and metals was intense during the early Bronze Age in many parts of Europe and Asia. Bharatiyas were also involved in this search and in discovering new alloys. The tradition of cire perdue technique of casting sculptures in bronze and in pan~ca loha (alloy of five metals) continues even today in Swamimalai, in Tamilnadu.

Early metallurgists of Bharat were also writers. They wrote on copper plates. They also wrote on punch-marked coins with exquisite symbols which can now be read as hieroglyphs.

Seafaring merchants from Meluhha traded with Mesopotamia and other neighbouring civilizations in copper, and other minerals. The rivers and the coastline constituted the waterways for trade contacts over an extensive area.

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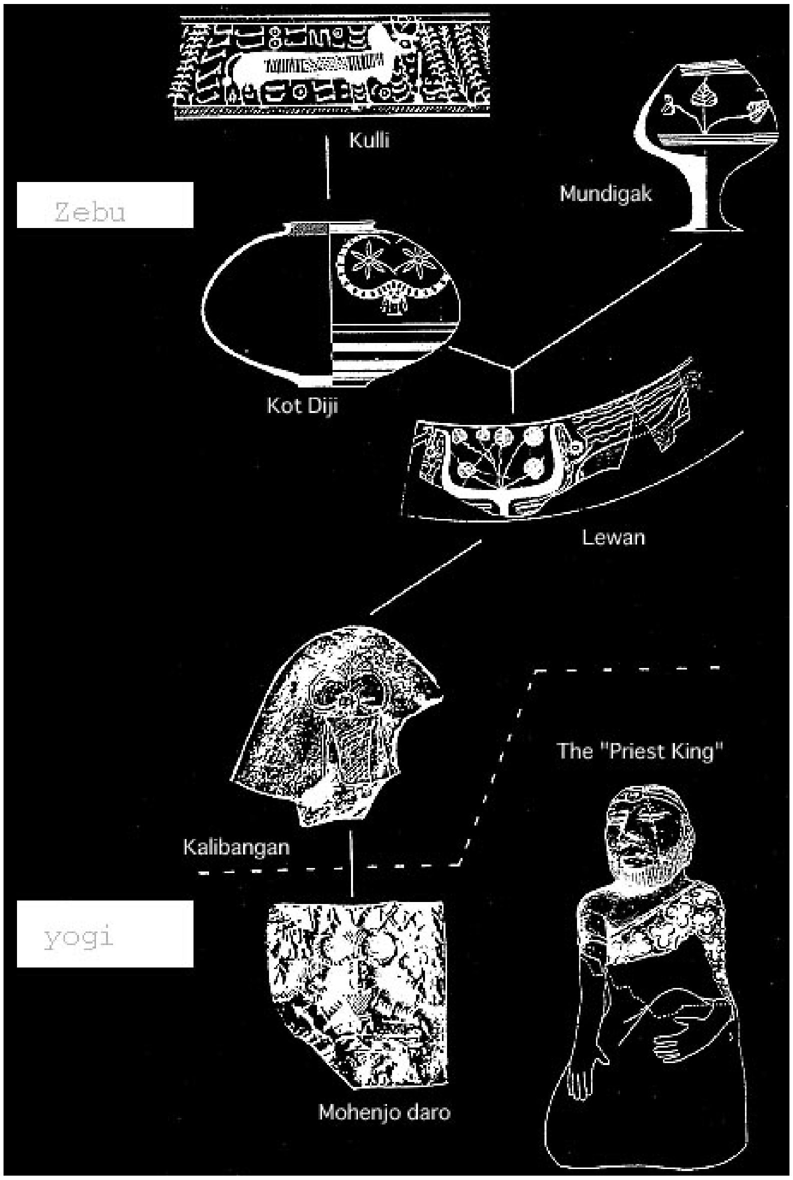
Vedi (fire-altar), metals, alloys, arms and armour



The stone sculpture of "Priest" from the Civilization may have originally had a horned head-dress affixed to the back of its head. Graphic reconstruction of the "Priest" [courtesy of Professor Michael Jansen (RWTH, Aachen University)] After http://bosei.cc.u-tokai.ac.jp/~indus/english/2_3_02.html

The zebu is: **ad.ar d.an:gra** (Santali); rebus: **aduru** 'native metal' (Ka.) **d.han:gar** 'blacksmith' (WPah.) The bull is tied to a post. **tambu** = pillar (G.); stambha id. (Skt.) Rebus: **tamba** = copper (Santali) **tamire** = the pin in the middle of a yoke (Te.) Rebus: **ta_marasamu** = copper, gold (Te.)

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Woman with horns and two stars: **ko_la** = woman (Nahali); rebus: **kol** 'metal' **ko_d.u** 'horns' (Ta.); **kod.** artisan's workshop (Kuwi) **ko_l.** = planet (Ta.); **kol** 'metal'; a pair (planets): **sagal.a** = pair (Ka.); **saghad.i_** = furnace (G.)

Ficus glomerata: **loa, kamat.ha** = ficus glomerata (Santali); rebus: **loha** = iron, metal (Skt.) kamat.amu, kammat.amu = portable furnace for melting precious metals (Te.) **kampat.t.am** = mint (Ta.) kammat.i_d.u = a goldsmith, a silversmith (Te.)

Seated person adorned with horns: **kamad.ha** = a person in penance (G.) Rebus: kamat.amu, kammat.amu = portable furnace for melting precious metals (Te.) **kampat.t.am** = mint (Ta.) kammat.i_d.u = a goldsmith, a silversmith (Te.) **cu_r.i** = bangles (H.); rebus: **culli** = fireplace, kiln (Ka.) The seated person's face is like a tiger's mane: **cu_r.i**

Priest: **tammad.a, tammad.i** = an attendant on an idol (Ka.); tammal.ava_d.u, tammal.i, tammad.i, tammali, **tambal.ava_d.u** (Te.) Rebus: **tamba** = copper (Santali) **tamire** = hole; **t.ebra** = three (cf. glyph of trefoil inlaid on the uttari_yam – upper garment); Rebus: **tamara** = tin (Ka.)

The Vedic roots of early metallurgy tradition of yajn~a, involving the construction and use of vedi or fire-altars, continue in the metallurgical traditions of Sarasvati Civilization. Many sites have been discovered with fire-altars and metallurgical artifacts of the early chalcolithic and bronze age, exemplifying evolution of pyrotechnology in working not only with stones, sea- and river-shells and terracotta obects but also with minerals and metals using fire and specialized furnaces.

New metallurgy techniques such as cire perdue (lost wax method) was an important technology which contributed to the evolution of tSarasvati Civilization from chalcolithic to the bronze age. Metallurgical technologies involved the production of (e.g. casting and forging including use of cold work, hot-work and annealing) and trading of artifacts made of gold, silver, lead, copper, arsenical copper, and bronze, with a dominant use of copper and copper alloys. Metallurgy was a Pre-Harappan technology exemplified by the copper mirror of Mehi displaying a female figure and a copper axe from Nal. The Mature Harappan phase built upon this technological foundation and established a network of interactions for resource mobilization of ores and for trade in intermediate products (such as ingots of copper and tin) and finished products (such as metallic weapons and tools and ornaments made of gold and silver and use of lapis lazuli, carnelian and other precious/semi-precious stones and beads). The weapon and tool repertoire included an array of flat celts, knives, arrowheads, spearheads, chisels, razors, fishhooks, saws, tubular drill, saw, needle with eye at the pointed end and vessels and vases. [DP Agrawal, 1971, *The Copper Bronze Age in India*, Delhi, Munshiram Manoharlal]. Over 200 Harappan artifacts have been subjected to metallurgical analysis; it was noted that 23% were alloyed with tin, 12% with arsenic and 80% with lead. [DP Agrawal, RV Krishnamurthy and Sheela Kusumgar, 1981, Arsenical coppers in the Indian bronze age, in: MS Nagaraja Rao, ed., *Recent Researches in Indian archaeology and Art history*, New Delhi, Agam Kala Prakashan, pp. 9-18]. This is contrasted with the situation of Copper Hoard culture which showed only arsenic alloying and of Chalcolithic cultures which showed only tin alloying. An analysis of two copper artifacts from Nagwada, a mature Harappan site of North Gujarat showed a chisel containing 10.6% tin and an axe containing 2.72% arsenic. [Seshadri, unpublished thesis, loc.cit. in DP Agrawal and Rajam Seshadri, 1998, The Metallurgical tradition of the Harappans, in: Vibha Tripathi, ed., *Archaeometallurgy in India*, Delhi, Sharada Publishing

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House, pp. 10-15]. Some of the c-14 dates for ancient copper workings are: 1. Dariba mines, Udaipur Dist., Rajasthan 3120+-160, 2310+-105 BP; 2. Ambamata, Banaskantha dist., Gujarat 2110+-200 BP; 3. Ingaldhal, Chitradurga Dist., Karnataka 1730+-110; 4. Ranihat, Tehri Garhwal 1690+-140 [DP Agrawal, C. Margabandhu and NC Shekhar, 1976, Ancient copper workings. Some new 14C dates, *Indian Journal History of Science*, 11, No.2, pp. 133-136].

In Swamimalai, 8 km. From Kumabakonam in Tamil Nadu, the **vis'vakarma** tradition of *cire perdue* technique of sculpting in bronze and pan~caloha (five metals) continues even today. Located on the banks of River Kaveri, this place has a natural resource: clay from the river banks, which is so fine that it did not crack when fired and would leave sharp imprints when pressed. The local tradition traces the technique of **madhucchis.t.ha vidha_na** to vedic times and equates the pan~cajana_h (five peoples) with: manu, 'iron monger'; maya 'wood worker'; tvas.t.a 'vessel maker', vis'vajn~a 'goldsmith'; and s'ilpi 'sculptor'. A person versed in the skill of any three of these professionals calls himself a **sthapati.** The processes involved in the technique of *cire perdue* in vogue are simple. A figure is hand-moulded using hard wax. The finished wax figure is encased in clay and sun-dried. The dried clay case is heated to melt and drain the wax. Molten alloy is poured into the hollow space. The rough cast which emerges is hand-finished to remove the rough metallic protrusions and polished. The technique can produce bronze sculptors which weigh as much as 2 tonnes and as high as 15 feet.cire perdue

The most exquisite example of the use of bronze is the bronze statuette of a

woman made using the **cire perdue** technique, a technique which is still in use in Swa_mimalai, Tamilnadu to make bronze images of utsava be_ra-s (mu_rti-s).

The bronze statue of a woman wearing bangles and holding a small bowl in her right hand, Mohenjo-daro (DK 12728; Mackay 1938: 274, pl. LXXIII, 9-11). The statue was made using *cire perdue* (lost wax) method, a method used by vis'vakarma-s in Swa_mimalai to make bronze figurines of deities – vis'vakarma tradition lives on.

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Dawn of bronze age in Bha_rata and cire perdue tradition of sculpting in bronze

“Copper and bronze implements included farming implements and tools, fishhooks, weapons, ornaments and vessels. These metal implements may have served as status symbols. They were manufactured in two ways: 1) by casting (pouring molten metal into moulds); and 2) by heating and hammering the metal into shape.” http://bosei.cc.u-tokai.ac.jp/~indus/english/2_2_05.html Many bronze implements are seen to have been made using *cire perdue* method.

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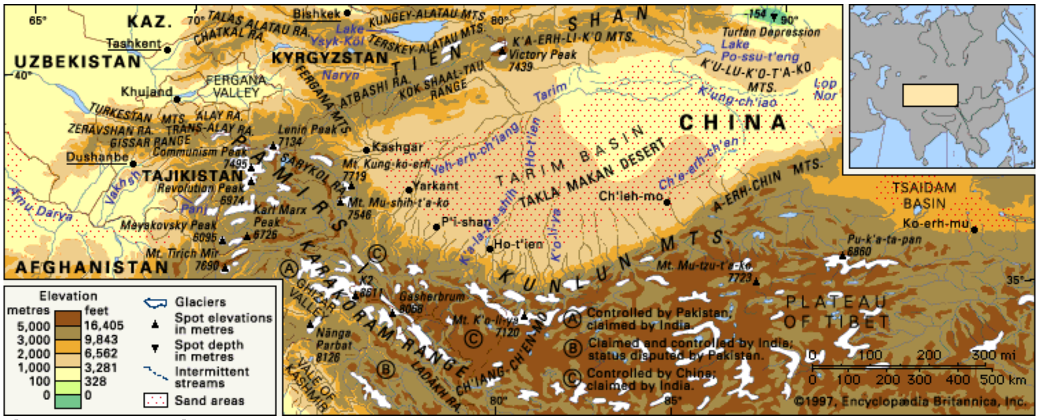
Bronze-age triangle: Sarasvati-Sindhu, Mesopotamia and Bactria-Margiana (Persia)

Hindukush region



Pamir-Kunlun region

The jury is still out on the issues related to dating the bronze-age artefacts in the three contiguous areas: India, Iran and Mesopotamia/Anatolia.

D.K. Chakrabari (1979, The problem of tin in early India--a preliminary survey, in: *Man and Environment*, Vol. 3, pp. 61-74) opines that during the pre-Harappan and Harappan periods, the main supply of tin was from the western regions: Khorasan and the area between Bukhara and Samarkand. The ancient tin mines in the Kara Dagh District in NW Iran and in the modern Afghan-Iranian Seistan could have been possible sources. Harappan metal-smiths used to conserve tin by storing and re-using scrap pieces of bronze, making low-tin alloys and substituting tin by arsenic. It is possible that some of the imported tin (like lapis lazuli) was exported to Mesopotamia. A cylinder seal of Gudea of Lagash (2143-2124 B.C.) read: "copper, tin, blocks of lapis lazuli-- bright carnelian from the land of Meluhha." (Muhly, J.D., 1976, *Copper and Tin*, Hamden, Archon Books, pp. 306-7).

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In a wide geographic span and over a wide time-horizon dating from c. 6000 BCE to c. 2700 BCE the starting point of the mature phase of Bharatiya civilization, some archaeological finds stand out. "In the Bolan valley or the Kachhi plain of Baluchistan Mehrgarh offers a straight sequence, beginning with a bead, presumably of copper, in a child's burial in the upper level of period I, which is unlikely to be later than 6000 BCE.. A bead and a ring occur in period II but do not indicate by themselves the beginning of the smelting tradition which, however, is beyond a shadow of doubt in period III (late 5th/early 4th millennium BCE) when some terracotta crucibles are found with metal sticking to them. The 4th millennium considerably widens the evidence, showing in addition the knowledge of lead, silver, nickel and gold. Gold occurs in Jalilpur I near Multan in central Indus valley, but lead, silver and nickel are attested at Nal in south Baluchistan, the last element occurring as an alloy (4.9%). The same specimen is also found to contain lead as an alloy (2.14%)." [Dilip K. Chakrabarti and Nayanjot Lahiri, 1996, *Copper and its alloys in ancient India*, Delhi, Munshiram Manoharlal, pp.33-34] Mackay (1938: 441) notes that it was proved "beyond doubt that bronze was known too and used by the people of the earlier occupations as well as later. For instance, bronze containing no less than 22.2 per cent of tin was found at the level 30.4 ft. below datum and another piece with 8.3 per cent of tin at 33.4 ft. below datum." About the metal finds in Lothal, BB Lal wrote: "It seems that the raw materials used by Lothal metal workers for the extraction of metal copper were different from those used at Mohenjodaro and Harappa, for, otherwise, it is difficult to explain the total absence of arsenic from the copper objects found at Lothal." (in Rao 1985: 655).

Distribution of artifacts in pre-Indus civilization levels[1]
[After Chart 1 in: Dilip K. Chakrabarti and Nayanjot Lahiri, 1996, *Copper and its alloys in ancient India*, Delhi, Munshiram Manoharlal, p.34]

Mehrgarh-I: bead; II: bead, ring; III: crucible, pin, seal; IV: chisel, rod
Kile Gul Mohammad-III: chisel/celt fragment
Damb Sadat-II: dagger/knife
Balakot-I: 4 objects including strip
Gumla-II: handled rod; III: antimony rod, nail-parer
Lewan-Kot Diji phase: rod, sheet, fragment
Tarakai Qila-Kot Diji phase: fragments
Amri-I: knife, bangle
Ghazi Shah: bead, bangle, ring, awl, arrowhead, crescent shaped object
Kot Diji-I: bangle, ring
Jalilpur-I: rod
Hakra Ware and Early Harappan phases in Cholistan: unspecified
Kalibangan-I: rod, ring, wire, pin, arrowhead, celt, bead, axe, bangle, 'lump'
Mitathal: bangle
Banawali-I: unspecified
Harappa-Early Harappan: unspecified
Dholavira: slag, crucible, 'fireplace'
Bagor-Phase 2: arrowhead, spearhead, awl
Ganeshwar-Phase 1: Mesolithic; Phase 2: arrowhead, awl, fish-hook, spear-head; Phase 3: axe, arrowhead, spearhead, chisel, fish-hook, ring, hairpin, bangle, rod, ball, celt
Kunal-Phase1: arrowheads, fish-hooks; Phase 2: arrowheads, beads, spearhead

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Artefacts from some other Indus civilization contexts levels

[After Chart 9 in: Dilip K. Chakrabarti and Nayanjot Lahiri, 1996, *Copper and its alloys in ancient India*, Delhi, Munshiram Manoharlal, p61]

Suktagendor: barbed object, bead, needle, knife, celt
Bala Kot: spearhead, arrowhead, bowl
Nausharo: arrowhead, blade, chisel, razor, pin, ball, seal, ring, button, lump, circular object
Gumla: chisel, antimony rod, handled rod
Lohumjodaro: spearhead, razor, awl, knife, ring, bead
Ali Murad: axe, awl
Shaji Kotiro: bangle, chisel, arrowhead
Thano Bula Khan: bangle
Naru Waro Dharo: spearhead
Allahdino: axe, spearhead, bead, pin, hook
Kot Diji: bangle, ring, blade, axe, chisel, arrowhead
Kalibangan: rod, pin, bangle, bead, mirror, arrowhead, hook, ring, chisel, spearhead, celt, awl, knife, dagger, drill, needle, razor, figurine
Banawali: arrowhead, spearhead, chisel, fish-hook, razor, ring, hairpin, rod
Mitathal: ring, wire
Ropar: axe, jar, spearhead, ring, bangle, razor
Alamgirpur: pin, fragment
Dholavira: seal, knife, chisel, bead, bangle, ornament, pieces
Nagwda: axe, chisel, pendant, ring, strip

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Metallurgy of Copper axe

"In terms of Brinell hardness, the axe of Mohenjodaro was 85 close to the cutting edge (the figure is much above that of mild steel), decreasing to 63 towards the middle of the blade. HCH Carpenter of the Royal School of Mines suggested that it is possible that the ancient axes do not retain their original hardness; it is also possible that such an axe was once harder. Mackay concludes from the examination of the rejected castings that the axes of Mohenjodaro were cast very much in the same shape as the finished specimen that we have found, even to the curved cutting edge; these would therefore have required not only hammering to shape them, but also possibly a great deal of hardening." (FEM, 594-95; A.K.Biswas, *Minerals and Metals in Ancient India*, Delhi, DK Printworld, 1994).

The copper tool-types and other metallic finds at Nal included; (after H. Hargreaves, 1929, repr. 1981, Excavations in Baluchistan Sampur Mound, Mastung and Sohr Damb, Nal, New Delhi: 40,44): adze, saw, chisel, dagger/spearhead; knife/dagger, seal (six projections, circular centre), silver foil (8 fragments); also, leaden slag and mineral ores (cerrusite with culrite; lollingite, i.e. iron and arsenic). "A point which is worthy of notice is that in the Hakra drainage area in Cholistan there is extensive evidence of presumably primary smelting. At the Indus civilization sites of Charaiwala and Siddhuwala Ther, Aurel Stein found copper ore (cf. Gupta 1989: 85,87), M.R. Mughal collected a large quantity of slag from the surface of many sites in this area (personal communication to N. Lahiri)…What, however, we find most intriguing is the emergence of the northern Rajasthan – southern Haryana centre with its focus around Ganeshwar in Rajasthan and Narnaul in Mahendragarh in Haryana as apparently the most significant copper metallurgical centre of protohistoric India, maintaining its prominence right through the early Harappan, mature Harappan, late Harappan and the chalcolithic cultures of southeastern Rajasthan and Malwa which were possibly contemporary with the late Harappan stage. It is obvious that the upper Gangetic valley centre became important only in the last and uppermost segment of this sequence, and till now we do not even know if it was really a case of a major copper metallurgical centre in the upper Gangetic valley or it was basically a case of expanded horizon of the northern Rajasthan-southern Haryana…What is further intriguing is the probable late Harappan association of this range of artifacts in the context of the upper Gangetic valley." (Chakrbarti and Lahiri, 1996, p. 61, 85).

Copper/bronze artifacts
Mohenjo-daro. Vessels.

Pl. CXL, 4: bronze, cast, dish and cover; dish dia. 6.55 in.
Pl. CDL, 7: copper, hammer, ht. 4 in.
Pl. CXL, 8: bronze, wide, mounted, plain rim; ht. 4 in,
Pl. CXL,9 and 18: copper, vessel and cover; ht. 12 in.
Pl. CXL, 12: bronze, plain flared rim; ht. 8 in.
Pl. CXL, 13: bronze, cast, dia. 12.75 in. ht. 4.4 in.
Pl,. CXL, 14: copper, plain rim 4.6 in. across; 9 in. high.
Pl. CXL, 20: bronze, small, flat base; ht. 10.5 in.
Pl. CXL,5: stem and base of a censer; copper axe decorated with a fluted pattern; slightly bent over rim with a raw edge carrying three rows of indented markings; the knob at the top of the stem of bronze; solid casting and very heavy; ht. 6.65 in. dia. 6.75 in.

Harappa. Jar 277 (Mound F) contained the following artifacts (Vats 1940):
13 blade-axes
8 narrow and long axes
2 double-axes
11 daggers with tapering sides and with or without curved tips
1 mace-head
13 spearheads and flaying knives
1 lance-head
1 arrow-head
1 chopper
2 saws
10 chisels with or without shanks
2 cast-bars for making chisels

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1 flat strip of metal
1 stylus
1 beam of a weighing scale
1 semi-oval, hollow terminal
5 solid bangles
1 rod for making a bangle
3 hollow bangles
4 flattened leaves for making hollow bangle
4 thick rectangular copper-pieces
1 thin bowl with tapering sides
2 large folded sheets of copper
2 thick broken pieces bearing prominent hammer marks
1 small lump of lollingite.

Types of objects found are: vessel, adze (one-socketed), dagger-knife, spearhead, chisel, sickle, scraper, razor, gouge, nail-parer, surgical or toilet set, cobbler's awl (?), needle, pin, antimony rod, mirror, fish-hook, arrow-head, hasp or a typical Induan kun.d.i made of a round copper bar, hook, and latch (?).

Mohenjodaro was an island between the Indus and the Western Nara loop (27.19N 68.8E). Bronze was used for weapons requiring sharp edges and for figurines or ornaments with fine finish. Another alloy of copper was found: arsenic averaging 3 to 4.5 percent in content. The arsenic component might have come from the copper ore itself or using another arsenic-containing mineral such as lollingite (MIC, I, 31). Weapons of war were: axes, spears, daggers, bows and arrows, maces, slings. No evidence of shields, helmets, or swords were found. Two types of blade-axes were: lay and narrow, shor and broad.

Based on the presence of arsenic, nickel and lead in artefacts from Mohenjodaro and Harappa, Ullah (1940) determined the sources of their copper to have been Khetri, Alwar, Singhbhum and Afghanistan mines where nickel and arsenic both are supposed to be present in the copper ores. He held that the Sumerian ores could be distinguished from Indian ores since the former are virtually free from arsenic (Ullah 1940)... Agrawal's Table 11 (1971) shows that at Khafaje and Ur, 88 percent of the artefacts contain arsenic.

Objects of copper: hook, axe, sword, knife, spearhead, pan, dish, chisel, vase, scale pan, bangle, canister, awl, saw, lance-head, razor, cones, dagger, ring, spoon, reamer, kohl-stick, sickle, casting, broken ingot, scale beam, fish-hook, copper lump, needle. Copper vessels were made in two parts and joined together by running on and rivetting techniques. (Soldering was used for gold and silver).

Objects of bronze: spearhead, mirror, vase, axe, pan, saw, chisel, dagger, axe-adze, fish-hook, scale pans, ornament, spacer, hook, knife, kohl-pot (FEM, 441-94). Short broad axes of copper and bronze, copper leather cuter, bronze razor and saw, bronze fish-hook were also found by Marshall (MIC, II, 488-508). Both bronze and copper were used as spacers and terminals for bead-necklaces. Gold and electrum were in use, in a significant measure with the possibility that cupellation was used to extract silver from its ores (perhaps argentiferous galena). Edwin Pascoe suggests that in ancient times, lead was extensively mined in various parts of India, chiefly to extract the silver associated with it. Hamid's analysis of samples of silver proved the presence of lead, thus enhancing the possibility that silver used in Mohenjodaro was an extract from an ore, perhaps galena rich in silver. (MIC, II, 524). Lead (with silver) was also available in the Fa_ranja_l mine in the Ghorband Valley of Afghanistan.

Marshall found in HR area, House VII an oval-shaped, 7 ft. long pottery kiln with a narrow mouth, surrounded by a thin wall of a single course of burnt bricks. A few betel-leaf-shaped clay plaques were found near the mouth of the furnace. A kiln in VS area, House VII had a circular shape and dia 6 ft. srrounded by a wall of a single course of bricks. This was possibly a pottery kiln (MIC, II, 226). DK mound, G section had six kilns, this mound was perhaps the artisans' quarter (perhaps potters). A number of copper melts found near House VI

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of Block 2 point to metallurgists at work. House VI, Room 51 yielded copper ore and a small piece of lead in a brick-kilned pit. Lead was perhaps used to assist smelt copper (FEM, 41). SW wing, room 33 produced two kilns, both 4ft. 3 in. deep and paved with brick, with a 4 in. ledge. The kilns were used to fire at high temperatures using wood or charcoal. (FEM, 49-50). At courts 21 and 26 two kilns had floor at a level of 3.5 ft, perforated with a number of holes for the heat of the fire to penetrate to the pottery. These holes were arranged in a ring round the edge of the floor with one hold in the centre. (FEM, 102). Mackay believed that G section DK kilns were to bake pottery but those in the 'palace' might have been used by an armourer in the making and repair of weapons and tools, which recall the armourer's shop in the palace at Kish. Copper ore came from Jaipur state in Rajputana, the Shah Maqsud in Southern Afghanistan and Robat in the extreme west of Baluchistan (MIC, II, 676). Lead was available from Afghanistan, Baluchistan, Rajputana and Hazaribagh. Tin content of 4.5-13.2 percent indicate the use of high grade bronze. Another proof is the completely oxidized state of a substantial core of white stannic oxide enveloped in a layer of red cuprous oxide in many objects. Bronze was used for tools, razors, jewellery (MIC, II, 481-83). It is likely that the discovery of bronze occured in North Persia. It is noted that daggers and knives discovered in the Mohenjodaro civilization resemble some weapons found at Susa, Anau and in SW Caspian areas (MIC, II, 483-84). Bronze statues (e.g. the dancing girl statue, animal figurines) were cast bronze perhaps using *cire perdue* process and also direct casting in a mould (FEM, 283-84, MIC, I, 345).

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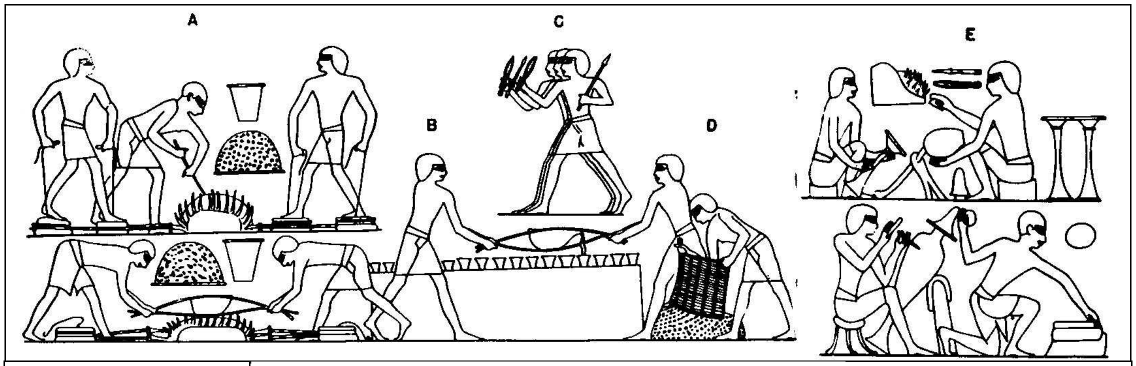

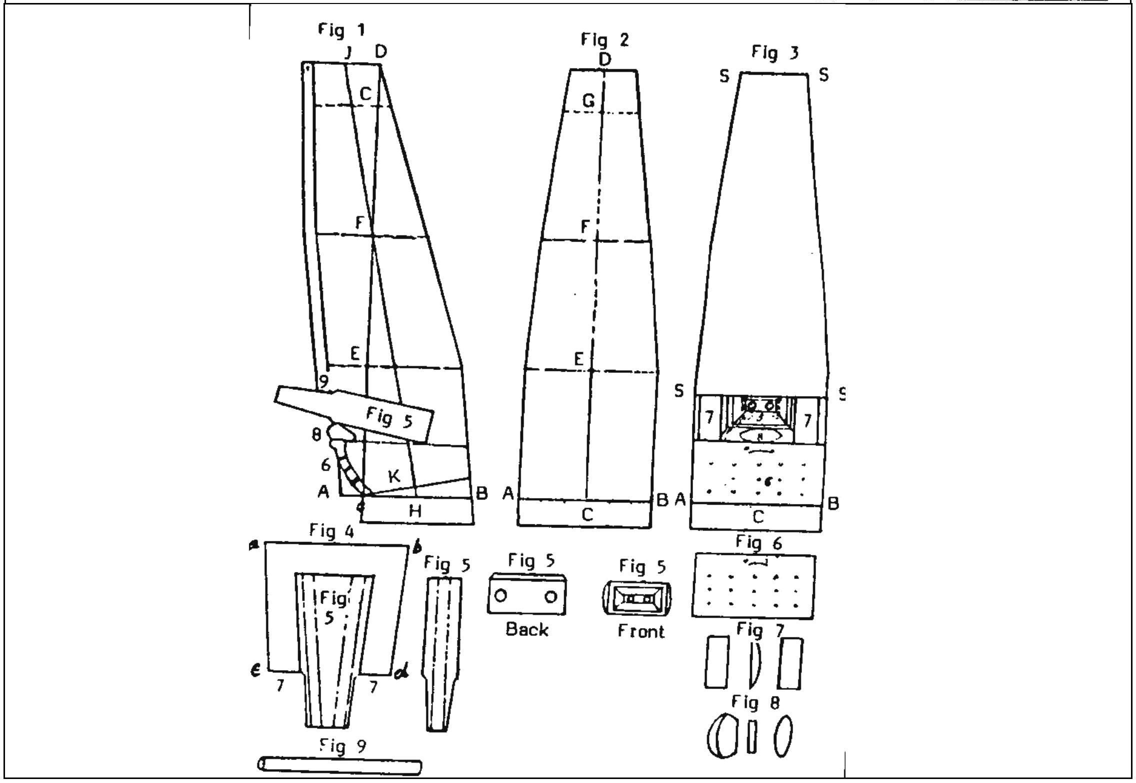

Egyptian metal-working (c. 1500 BCE). From a wall-painting. Metropolitan Museum of Art. A. Fires are blown to a glow by wind from bellows worked with the feet and with cords held in the hands. In the lower register metal is melted in a crucible held over the fire between two rods. B. Molten metal poured from crucible to moulds. C. Workmen carrying tongs and blow-pipes. D. Labourer emptying basket of fuel, probably charcoal. E. Vessels beaten into shape by stones on anvils, polished smooth by small pebbles, and ornamented with incised decoration. The fire in the small furnace was probably used for soldering.

Geometrical outline of a furnace used by iron-workers in Bha_rata. [After Plate 3, Sayed Jafar Mahmud, 1988, *Metal technology in medieval India*, Delhi, Daya pubishing house]. **Akaira** is

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shown in figs. 4 and 5. It is seen externally as a clumsy mass of clay enveloping the wind tubes (two are shown in fig. 5 within Akaira; the complete fusion of this mass and the perfect completion of the smelting process must be simultaneous results, hence Akaira is an important component of the furnace. If Akaira is too small, masset of crude iron will be full of impurity; if it s too large, the iron will be consumed; if the Akaira cracks during smelting, the entire furnace will have to be dismantled and re-worked. **Guddaira** is a wedge of clay used to adjust the vertical position of the Akaira; **Pachar** is an oblong plate of clay used to wall up the orifice after the Akaira is placed (figs. 7 and 8 respectively). **Gurairy** is a convex plate of clay, perforated with holes and used as a grate through which the scoria are drawn off (fig. 6).

"The man that could make metals was, as one would expect a powerful and important figure. His power sometimes led to his being worshipped; alternatively, he might have been hated. In some tribes, apparently, to call a man 'a smith' was an extreme form of abusive language. Not surprisingly the metal-makers' craft was associated with magic and wizardry. Perhaps that is how the name 'blacksmith' came about. After all, if a man could turn a piece of hard, dull rock into soft, bright metal he was certainly one to be held in respect, or fear. Consequently, the smith's hammer was a sign of power, and an oath taken over his anvil could never be broken. (The importance of a promise make over a blacksmith's anvil was, until recently, well appreciated -- or should have been -- by eloping couples who fled to the Scottish border where they were married by the smith at Gretna Green.) Further, the smith was supposed to be able to fore-tell the future by looking at the molten slags in his furnace. Of course, the contemporary metallurgist should be able to foretell the immediate future by looking at his slags; he may even foretell the value of some industrial stocks; but the old smith's abilities went further than that." [J. Gordon Parr, 1958, *Man, metals and modern magic*, Cleveland, American Society for metals].

The R.gvedic and Avestan *kavi* was a smith; kavyava_hana was agni, the carrier of the *havis* (oblation) of *kavi*. He was the singer par excellence, the singer of *sa_man*, the processor of *soma*, electrum.

Weapons of War and defensive fortifications in Sarasvati Sindhu Civilization

Most of the settlements of the civilization were fortified in the citadel areas aligned in cardinal directions. Many place names of the settlements are referred to as ‘kot.’ meaning, ‘fort’: e.g., **kot.ada** (Dholavira), **Surkot.ada**, **Kot. Diji**. In harmony with the fortified nature of the citadels some with towers close to gateways, the metals technologies were used to produce – arms and armour – or, weapons of war, in addition to utilitarian and craft tools and implements.

> “In considering the possible implements of war, we may reject the simple chert blades which occur abundantly on all Harappan sites, as on many others of the same general period. But alongside these are found metal implements of which a majority may have been used equally by the soldier, the huntsman, the craftsman, or even by the ordinary householder, and are included in this section without prejudice. They are of copper or of bronze generally poor in tin, and include spears, knives, short swords, arrow-heads and axes. It has been suggested that small domed pieces of copper, each perforated with two holes, were sewn on to a garment and used as an equivalent to mail, but there is no supporting evidence and neither body-armour nor helmets (well known in Ealry Dynastic Sumer), nor indeed shields, can at present be attributed to the Harappans. Spears are invariably tanged and cannot clearly be distinguished from knives. Most of them are thin, flat, leaf-shaped blades which would buckle on impact and must have been stiffened by being set back between the split ends of the shaft, which would thus serve as a mid-rib. Sometimes two two small holes near the base of the blade suggest a former binding for such a device. Rarely (in four instances) the blade has a slight median thickening, the section being

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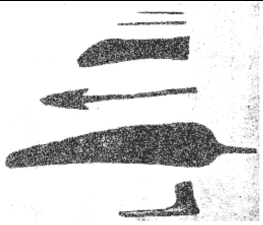
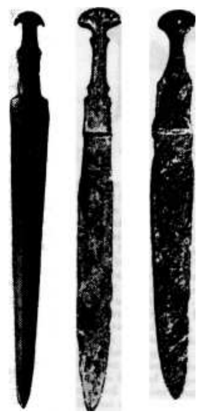
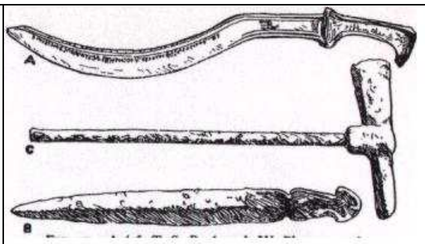
diamond-shaped. Such re-inforced blades are up to 18.5 inches in length and may rather represent short swords or dirks, a type of weapon for which there is no other evidence. They are from late levels, and have parallels of c. 2200-1750 BCE in Syria and Palestine. The leaf-shaped spearhead is universal; no barbed blade has been found, although there is a clear illustration of a barbed spear on a Mohenjodaro seal, and a barbed spearhead from Ur has been cited in this connection…Leaf-shaped knives may sometimes be differentiated from spears by having a slightly sinuous, recurved point, a Harappan peculiarity hardly ever found outside the Indus civilization, although one example is reported from Hissar III in north-eastern Iran. The appearance of a hafted knife is summarily indicated by a tiny graffito on a potsherd from the Great Granary.

"Arrow-heads are fairly numerous and are almost invariably of copper or bronze. They are thin and flat, with long, narrow barbs and no tang, resembling the swallow-tailed flint arro-heads of Egypt and northern Iran. The metal type does not occur in Egypt or Sumer, but is found in Minoan Crete. On the other hand, flint or chert examples are almost unknown in the Indus valley: exceptions are from Kot Diji and from Periano-ghundai in northern Baluchistan. Copper or bronze axes are flat, without the shaft-hole which had early developed elsewhere in Western Asia. They were presumably hafted in a split and bound handle. Some of the axe-blades are long narrow, with neatly parallel sides and may sometimes have been used in prolongation of the haft; others are short and relatively wide, with boldly expanded edge."[REM Mortimer Wheeler, 1968, *The Indus Civilization*, 3rd edn., Cambridge University Press: 73]

Regarding shaft-hole axes, it should be noted that two pottery models of shaft-hole axes are recorded from Mohenjodaro, recalling the occurrence of similar clay models as early as the al'Ubaid period in Mesopotamia; and a bronze example was found at Chanhudaro in a late Harappan Jhukar layer. More elaborate is a fine copper axe-adze from a late level at Mohenjo-daro, analogous to the ones found in Hissar, Shah Tepe, Turang Tepe, at Faskan and Maikop in North Caucasia, at Assur (859-824 BCE, King Salmanassar III). A similar type is also found in Crete (c. 2000-1900 BCE) and as far as away as Ukraine (mid-2nd millennium BCE). The Mohenjo-daro axe-adze can be dated to the 2nd millennium. [DP Agrawal, 2000, p. 72].

 **Bronze daggers from a. Punjab (National museum of antiquities, Edinburgh; b. Luristan; c. Nihavand, West Persia (c. 1200-1000 BCE?)** [After Fig. 2 in Heine-Geldern, 1937].		 **Sumer; Top to bottom: two bronze drills, a copper axehead, a copper spearhead, a copper saw blade and a bronze adzehead.** (From S.N.Kramer, 1957, opcit., p. 155).

A. bronze scimitar, over 21 in.; length of the blade 16 in. and of the hilt about 5 in., width varies from over one to just under 2 in.; the hilt was jewelled and inlaid with ivory; bears an inscription of Adad-nirari I, king of Assyria ca. 1325 B.C. B. Straight sword found at Ashur C. Bronze axe (A:

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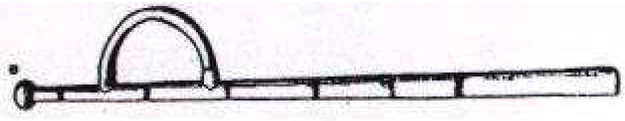
Boscawen, 1876, *Transactions of the Society of Biblical Archaeology*, Vol. IV, Pl. 2, p. 347; B: cf. Andrae, Der Anu-Adad Tempel, p. 53; C: Andrae, ibid.) In the inscription of Cylinder A, Gudea describes his involvement with craftsmen: "the ruler sat with the silversmiths building Erinnu with precious stones, he sat with the jewelers building with copper and tin Ninturkalamma (godess) directed before him the craftsmen and metal casters (Jacobsen 1987: 408). Neo-Assyrian ruler Sennacherib also shows his interest in metalworking: in one inscription he claims innovation in casting colossal metal statues (cf. Dalley 1988: 103-5); in another inscription, a reference is made to the alloy used for casting ornamental metal friezes for gates (cf. Walker 1988: 116).

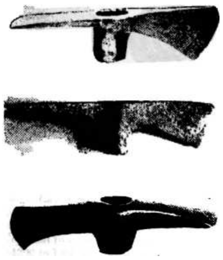


Hollow pipe of beaten copper over ten feet long and dia. of 4 in.; the tube was fastened to a wooden pole with copper nails; the pipe tapers upwards and the top is crowned with a hollow ball of hardened bitumen
a little below which there is a large semicircular handle which is also a hollow tube made of copper; it appears to be part of a standard as it is found reproduced on the famous vase of Gudea.

Shaft-hole axe with horse-head. Afghanistan, early 2nd millennium BCE. The blade is balanced with the protome of a horse projecting from the back of the butt. The blade of the axe is thicker than most. An axe with a lion emerging from the butt is also known. Copper alloy. 7.9 cm. High, 14.9 cm. Wide. Metropolitan Museum of Art, new York 1989.281.39 [After Holly Pittman, 1984, *Art of the Bronze Age – southeastern Iran, western Central Asia and the Indus Valley*, New York: 70, fig. 32].

Mace-head with a horse-head. Northern Afghanistan. Copper. After Viktor Sarianidi, 1986, *Die Kunst des alten Afghanistan*. Leipzig: 211.

Sibri: Shaft hole axe-adze (*South Asian Archaeology*)



Axe-adzes of bronze: (a) and copper (b,c). From a. Mohenjo-daro; b. Tepe Hissar, Near Damghan, North Persia; c. Zsiberk, Transylvania (National Museum of Hungary, Budapest). [After Fig. 3 in Heine-Geldern, 1937].

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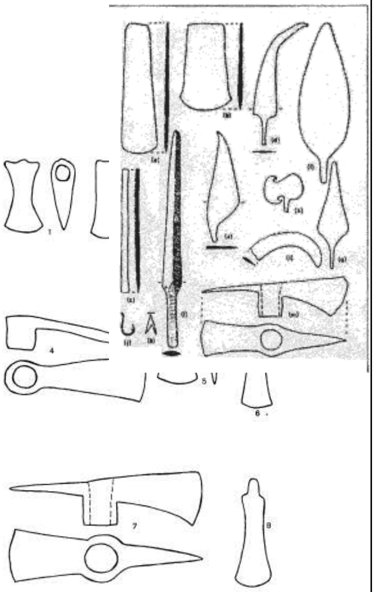
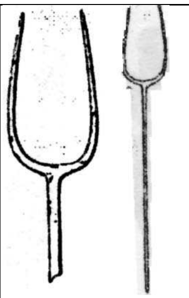


Copper and bronze objects from the Indus system: shaft-hole axes: 1. Chanhu-daro (Jhukar culture); 2. Shahi-tump cemetery; 3. Mundigak III.6; shaft-hole adze; 4. Mundigak III.6; Trunnion axes; 5. Shalozan; 6,8 Gilgit Karakoram; shaft-hole axe-adze; 7. Mohenjo-daro [After Fig. 9.3 in: Bridget and Raymond Allchin, 1982, *The rise of Civilization in India and Pakistan*, Cambridge University Press].



Copper forks from Tepe Hissar "Such forks are known from a necropolis at Sialk, near Kashan, half-way between Tehran and Isfahan, dating from the twelfth or eleventh centuries BCE. They are frequen tin Transcaucasia, dating, there too, from the last centu[After Fig. 4 in Heine-Geldern, 1937].

Bronze knife, sickle, chisel: Harappa, 1995 excavations. [Fig. 5.25 in DP Agrawal, 2000].

Copper razor (sickle?) wrapped in cloth, indicating packaging for trade or use of a sheath: Mohenjo-daro {After Fig. 5.21 in DP Agrawal, 2000].

S'atapatha Bra_hman.a attests to the use of copper needles and a copper slaughter knife, during the performance of the As'vamedha yajn~a. (S'Br. 13.2.2.16,18; 2.10.3). S'atapatha Bra_hman.a refers to **ta_mramayah ks.urah** (copper razor) in the context of shaving ceremonies (S'BR. 2.6.4.5, 6,7;

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cf. Eggeling 1882, I:450; Weber 1849: 219). A_s'vala_yana Gr.hyasu_tra (1.17.9), Para_sara Gr.hyasu_tra (2.2.11) and Sa_n:kha_yana Gr.hyasu_tra (1.28.7,14; cf. Oldenberg 1886, I: 55,56,185,302) also refer to the use of copper (**loha, loha_yasa**) razor in shaving (tonsure) ceremony.

"The Sm.rti texts go beyond mere rituals and provide an insight into the role of the state in relation to mines, minerals and metal-working. According to the *Manusmr.ti* (8.39; Dongier and Smith 1991: 155) "the king gets halof of ancient treasures and minerals in the ground". The Vis.n.usmr.ti (3.55; Jolly 1880: 19; 1881: 13) allots the whole produce of the mines to the king. This text further notes (3.16) that the king should appoint able officials for the working of his mines. Interestingly, this text (54.19; Jolly 1880: 177; 1881: 125) also alludes to the fact that the selling of metals, as also of shells, bees wax, lac and rhinoceros horn were activities associated with people viewed as polluted in the traditional Hindu system. It may also be useful to recall that the Manusmr.ti (6.71) shows an awarness of metallic ore-processing: 'for just as the defiling dirt of metal ores is burnt away in the blast of a furnace, so the faults of the sensory powers are burnt away by suppressing the breath.' (Dongier and Smith 1991: 124; also Buhler 1886: 211 and Jolly 1887: 122). While the law books of A_pastamba and Gautama are quite early (600-350 BCE), the Manusmr.ti is dated between 200 BCE and CE 200 (Kane 1968, I). The Vis.n.usmr.ti, while containing an early prose nucleus, is dated in its larger verse elements between CE 400 and 600 (Derrett 1973: 38)." [Chakrabarti and Lahiri, 1996, pp. 138-139].

Bronze vessels and artifacts; bronze jar: Mohenjo-daro [After Fig. 5.15 in DP Agrawal, 2000].

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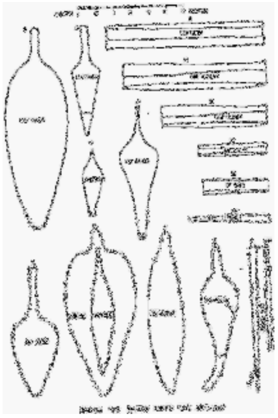
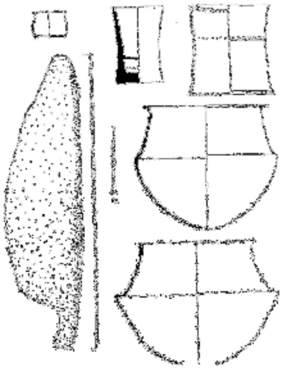
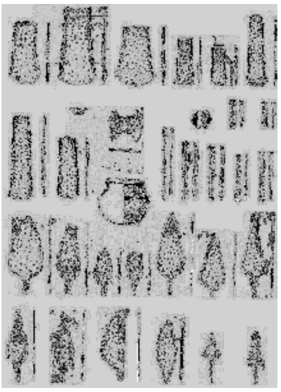
“**The Harappans had a well developed and highly specialized metal technology, but oddly enough it is one of the least studied craft traditions**.” [KK Bhan, Vidale Massimo and Jonathan Mark Kenoyer, 1994, Harappan technology: theoretical and methodological issues. *Man and Environment* 19: 141-57].

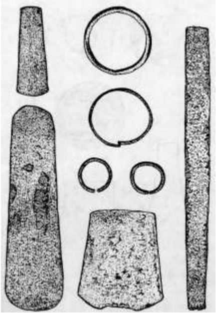






Most artifacts are utilitarian with an array of pots and pans in metal. ; images of dancer, foot with anklet, cast figures of animals show the use of lost wax (cire perdue) method of casting of copper/bronze. The major weapons are: sickle blades with externally sharpened edge; chisels; spearheads, thin barbed arrow-heads; straight and circular saws; blade-axes; mid-ribbed daggers; drill, and eyed needles. “It may be pointed out that needles with eyes on the pointed ends, true saws, circular saws, and drills are Harappan contribution to the world of instruments.”

About 30 % of metal artifacts of Mohenjo-daro and Harappa were alloyed: arsenic alloys (1 to 7 %); nickel alloys (1 to 9 %) and lead alloys (1 to 32 %). “Tin bronzes were more common than any other alloys. The Harappans knew the techniques of sinking, ‘rising’, ‘running-on’, cold work, annealing, riveting, lapping, closed casting, cire perdue.” (DP Agrawal, 2000, pp. 71-72).



Copper finds from northern Rajasthan-southern Haryana area (After Yule 1985, pl. G).

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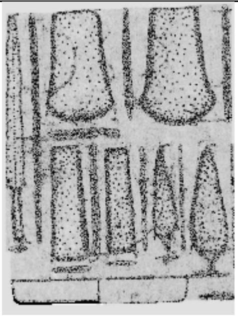
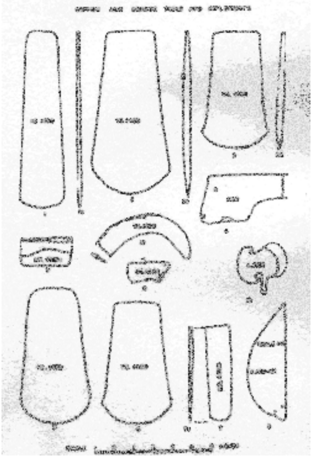
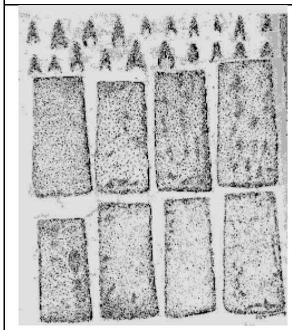


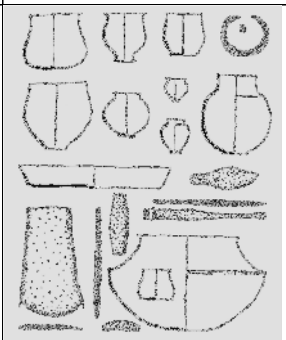
Mohenjo-daro: copper objects (Afte Mackay, 1938, pl. CXVI)

Mohenjo-daro: copper objects (Afte Mackay, 1938, pl. CXV)
Mohenjo-daro: copper objects (Afte Mackay, 1938, pl. CXIII)
Mohenjo-daro: copper objects (Afte Mackay, 1938, pl. CXII)





Ganeshwar. Copper objects (After Yule, 1985, pl. 7).



Use of copper articles according to Vedic texts [After Chart 44 in Chakrabarti and Lahiri, 1996]

Ceremony	Text	Reference
Funerary	A_s'vala_yana Gr.S. 4.6.19; 7.10	Oldenberg 1886,I: 250-51
	SS'S 4.12.8	
	A_pastamba	Caland 1953:98ff.
	Dharmasu_tra 2.8.19.3	Buhler 1897, I: 149
	KSS 21.3.7	
Pitr.medha		Ranade, 1978: 552-53
	KSS 5.2.17	Ranade 1978: 229
Ca_turma_sya		
	KSS 20.7.1,4	Ranade, 1978: 545,21
As'vamedha		Ranade 1978: 229
	KSS 7.4.22	
Agnis.t.oma		

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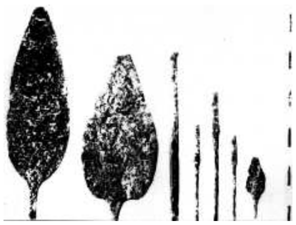
Copper/bronze weapons: Harappa [After 5.5 and 5.6 in DP Agrawal, 2000] Copper weapon types;

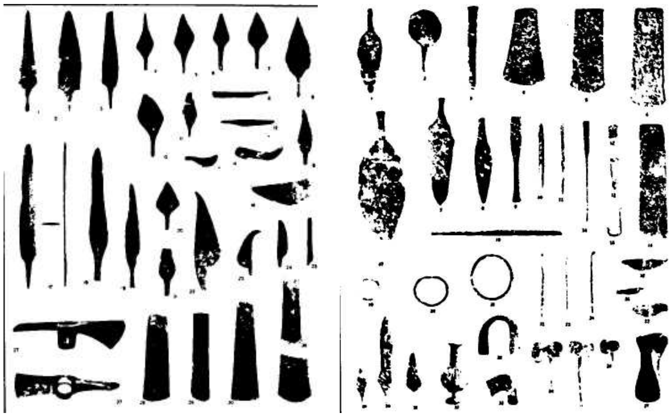


Spearhead and splayed blade: Harappa (After 5.8 and 5.9 Harappa 95 excavations].

Bronze spearheads and chisels: Mohenjo-daro [After Fig. 5.24 in DP Agrawal, 2000]. **Spear/lance-head**

Pl. CXXV, 2: copper, 9.1 in. long, 4.1 in. broad.

Pl. CXXXV,8: copper, 11.3 in. long, 3.5 in. broad. The blades could have been shafted to bamboo shafts.



Bronze weapons: spearheads, blade-axes, shaft-holed axe; socketed axe (37) and other weapons: Mohenjo-daro. [After Figs. 5.16 and 5.17 in: DP Agrawal, 2000] Blade-axe. "The general slope of the cutting edge is on both sides, except in one case where there is a 'true chisel-edge', the slope being only on one side." (p.78).

Chanhujo-daro. Utensils. Pl. LXXIII,37: A copper canister fitted with wire loop handles. Pl. LXXIII,39. Fluted cosmetic jar with a narrow mouth and a long neck. **Other finds.** Jar covers, scale-pans and beams, blade-axes (some **inscribed**), adzes, saws, spearheads, daggers, large and small knives, razors (u- and crescent-shaped), arrow-heads (tanged – Pl. LXXIII,1 and 13), chisels, fish-hooks, awls, rods, tubular drills, ingots and plumb-bobs. 'Bead-tools' of Chanhudaro (Pl. LXXX, 1-8) used to produce minute steatite beads. A shovel (Pl. LXXIV,13) and a spatula (Pl. LXVII,8) were also found. To surmount ceremonial staffs, stave heads (Pl. LXVIII, 4,5,7) may have been used. A find of 37 pieces of unfinished castings (perhaps meant for manufacturing implements), a bronze rod (13.75 in. long, which may have been an ingot: Mackay 1943: 187) attest to a metalworkers' area. "Heidi Miller has studied 521 objects from Chanhudaro…37 copper vessels…There are 334 metal artifacts classified into 15 tool types and no single type makes up more than 17.2% of the category. There appears to be a range of tool types with no dominating specific type, suggesting that copper alloy tools were used for a variety of purposes. **Only three copper objects from Chanhudaro are inscribed; type 14, described by Yule as a 'snarling iron', and two examples of tool type 3A blades.**" [DP Agrawal, 2000, p. 87].

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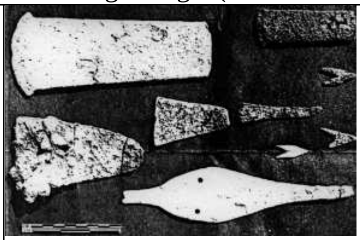
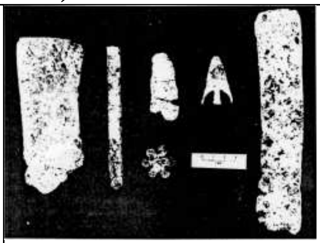
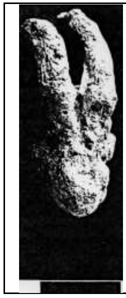
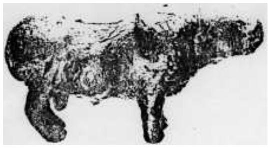
Blade-axes.

Pl. CXXXVIII,1: copper, 8.9 in. Long and narrow type
Pl. CXXXVIII,7: copper, 4.82 in. long Long and narrow type
Pl. CXXXVIII,2: copper, 8.25 in., rounded cutting edge. Short and broad type.
Pl. CXXXVIII,6: copper, 6.25 in. long, rounded cutting edge, sharply sloped on both sides, butt end with a blunt edge. Short and broad type.

Chisel."The flattened shanks are expressly meant to be fixed in handles. The pointed chisels with round sections were means for cutting stone…They were probably employed for simple woodwork, and it may be for soft stones, such as steatie, which was very commonly used at Mohenjo-daro. The smaller tools were perhaps employed for engraving." (Marshall 1931: 502).

Blade-axes, arrow-heads, splayed blade, spear-head, chisel: Dholavira. [After Fig. 5.28 in DP Agrawal, 2000]. Arrow-heads from Harappa 1995 excavation. [After Fig. 5.29 in DP Agrawal, 2000].	 **Awl and Reamer.** Pl. CXXXV,7: copper, 7.7 in.	 Pl. CXXXV, 11: copper, 9 in. long. Pl. CXXV, 12: copper, 8.2 in. long. **Sword dirk.** Pl. CXIII,3: copper, blade and tang 15.75 in. long; two rivet holes at the junction of the tang and the blade.

Copper arrow-heads and other implements: Balathal, Rajasthan [After Fig. 7.12 in: DP Agrawal, 2000].

Bronze ram on stand, DK area, Mohenjo-daro. No. DK 10781.

Bronze. Horned goat from Harappa 1995 excavation. [After Fig. 5.26 in DP Agrawal, 2000].

Bronze antelope: Mohenjo-daro [After fig. 5.11 in DP Agrawal, 2000]

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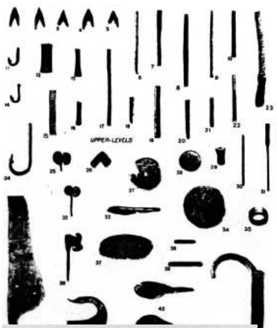
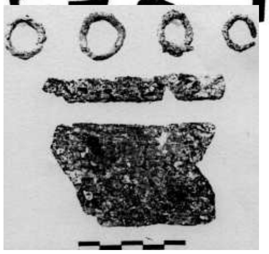
Two views of a bronze buffalo: Mohenjo-daro. No. Sd. 3319.

Rings, knife and blade from Harappa 1995 excavations. [After Fig. 5.27 in DP Agrawal, 2000].

Copper/bronze weapons including arrow heads, DK Area, Mohenjo daro [After Fig. 5.23 in DP Agrawal, 2000]. **Arrow head.** Pl. CXLII,12: 1.3 in. long, .5 in. thick. **Knife/dagger.** Pl. CXXXV,3: copper knife, 6.7 in. long, 1.23 in. wide. Pl. CXXXV,6: copper, a leather cutter? 6.2 in. long

Razor. Razors were classified into double-blade, L-shaped, hook-shaped and simple-bladed sub-types. The double-blade type was most common. 'The blades are always very thin and paper-like, and the tangs which are oval in section are not very much thicker. It will be noticed that the two blades of a razor are not the same shapes; probably each side had its own purpose. They were roughly cut out of sheet metal and the blades subsequently spread by means of a hammer before being finally trimmed into shape. None of these razors is very large, the biggest that we have found being only 2 inches across the blade. It seems unlikely that they were set in handles, for in the better preserved specimens the metal tang, thin as it is, would suffice for holding blades as light as these.' (Mackay 1937-38: 468) (DP Agrawal, 2000, p.79).

Pl. CXXXVIII,11: bronze? 2.2 in. long.
Pl. CXXXVIII,12: bronze, 2.28 in. across, sharp curved edge.

Saw. Pl. CXXXVIII,8: bronze 'is of much the same shape as the iron saws used of the present day to cut up shell'; 18.3 in. long; 2 holes in the tang for riveting.
Pl. CXVL,5: irregular teeth like the ones found in a modern saw; riveted to a handle.

Sickle-shaped blade. Pl. CXLIII,25: bronze, 1.95 in. long.

Fish-hook Pl. CXLIII,25: bronze; 1.95 in. long.

Lothal. About 1500 copper/bronze artifacts were recovered. A flat axe with a long narrow blade or a broad one. A second type of axe has a thick triangular section. One had a shaft-hole, a 'crescentic sleeved axe' (Rao 1985: fig. 107). Dagger specimen range from 1 to 4 inches. Arrow-heads are .75 to 1 in. long. Razors had curved, L-shaped blades. Three types of chisels were found: square./rectangular section with parallel margins; square/rectangular with flat tangs; blade with round section. A drill-bit 'has twisted grooves with a chisel end and works exactly like a modern auger. It must have been fitted into a T-shaped frame to bore holes by rotary movement with downward pressure.' (Rao 1985: 532). One type of awls and needles had a pierced eyelet at the sharpened end. A partly damaged saw with a curved blade 'must have been used for cutting grooves in ivory and shell objects of circular shape, e.g. gamesmen, rings, etc. or for trephining' (Rao 1985:

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533). That five rectangular sink-like brick pavements were a coppersmith's workshop is surmised by the presence of a pot furnace containing ash near each sink as also bits of muffles. Two terracotta crucibles, small lumps of copper and a crescentic sleeved axe were also found in this area. Near the workshop was found a circular kiln of mud bricks (6ft. dia, 2 ft. 3 in. deep) which may have been used for remelting ingots. In a room of a mud-brick structure, a rectangular furnace of burnt bricks was discovered; the kiln had ash and fragments of terracotta crucible together with a cubical stone anvil. Pointers to copper/bronze manufacture were the finds of: a stone mould for casting pins and awls, a copper pin, a broken copper chisel and a hammerstone with a socket for hafting. [DP Agrawal, 2000, p. 85].

Banawali. Copper/bronze finds included: arrow-head, spearheads, a fragmentary sickle blade, typical razor, chisels, rings, double-spiralled and simple pins, ear/nose rings and fish-hooks. "There are points, a knife and scrapers of bone." [RS Bisht, 1993, Excavations at Banawali: 1974-77 in: GL Possehl, ed., *Harappan Civilization: A recent Perspective,* New Delhi, Oxford and IBH: 113-24].

Double spiral-headed pin. Manda. [After Pl. 16.2 in GL Possehl, 1982].

Rojdi. Chitalwala [YM Chitalwala, 1989, The small finds. In GL Possehl and MH Raval, eds., *Harappan Civilization and Rojdi*, Delhi, Oxford and IBH, pp. 157-97] details the following copper artifacts: axe (14.8cm.], bar celt (32.1cm.), paras'u or knife (17.5 cm.), [**One side of the paras'u has an 'endless knot' design on it.]** ornaments, bangles, toe-ring, rings, pin.

Padri.A unique fish-hook is reported. [VS Shinde and Elizabeth Thomas, 1993, A unique Harappan copper fish-hook from Padri, Gujarat, *Man and Environment* 18: 145-47]. It is 14 cm. Long with a barbed point and a loop at the other end and weights 45 gm."..probably used to catch large marine fish…The Indus valley fish-hooks are similar to modern ones and this feature is suggestive of a continuity of this culture-trait. The best metallic fish-hooks were probably developed by the Harappans, and were certainly superior to those from contemporary sites in Egypt and Mesopotamia."

Surkotada. The site yielded 129 objects, apart from a hoard containing beads and bangles. The main finds are: simple blade and crescent-shaped blade, long or short chisel with rectangular section long and narrow blade, arrow-head, knife with thin leaf-shaped blade, drill, spearhead with a tang, lid with raised edge, socketed axe, fish-hook, antimony rod, bangle, ring, ear-ornament, hook and chain. [JP Joshi, 1990, *Excavations at Surkotada 1971-72 and Exploration in Kutch*, New Delhi, ASI: 266-74].

Late Harappan repertoire. From Haryana and Punjab sites: Bara: bead, fish-hook; Bhagwanpura: rod; Dadheri: chisel, hook; Daulatpur: bangle, fish; Hulas: bangle, chisel, ring and wire; Mitathal IIB: several pieces of bangle, flat; Raja-Karan-ka-Qila: spearhead; Sanghol: chisel, celts, one paras'u (a sort of double-axe). From Swat-Chitral Area: Ghaligai: spearhead, hook; Loebanr III: pin, fish-hook, chisel, wire; Bir-Kot-Ghundai: pin, fish-hook, point, wire; Loebanr: [**Site of major**

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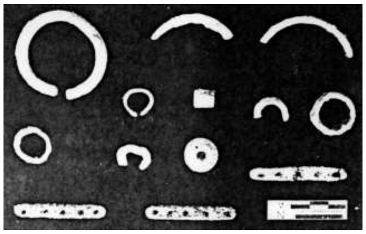
evidence of copper smithy in a pit containing ashes and charcoal and a chisel] pin, earring, knife, pendant, buckle, spearhead, bead; Katedai: pin, earring, bead, pendant, knife, bodkin/needle, fish-hook, horse figurine; Butkara II: pin, knife, buckle, earring, hook; Timargarha: pin, toilet object, needle, hairpin, pendant, earring, bangle; Zarif Karuna: ring. From Proto-historic Kashmir: Burzahom: arrowhead; Gufkral: hairpin with coiled head.



Copper ornaments: Dholavira, Gujarat. Spacers, rings and bangles. [After Fig. 5.22 in DP Agrawal, 2000].

Daimabad copper /bronze finds are Late Harappan. Some finds weigh a mighty 29 kg. Used in statuary. "The chariot and bull are the most remarkable pieces in the hoard. Its total length is 45 cm. And the width is 16 cm. The complete bronze consists of an elaborate chariot yoked to two bulls and driven by a man standing within it. Two solid wheels rest over the light body of the chariot. The wheels have a projecting hub on the inner side in which the axle is fixed so that it moved along wth the wheels. This is an extremely interesting feature. The elephant is the largest of the three animals in the hoard. The beast stands on a platform 27 cm. Long and 14 cm. Broad…in all probability the bronzes in the hoard belong to the late Harappan period at Daimabad, and that they were probably imported from Harappa, or some smith from Harappa made them locally." [MK Dhavalikar, 1993, Daimabad bronzes, in: GL Possehl, ed., *Harappan Civilization*, Delhi, Oxford and IBH, : 421-26].

Banas Culture (c. 2200- 1400 BCE)

Copper dagger with tang, Chandoli, Maharashtra. [After Fig. 6.2 in DP Agrawal, 2000]. The hilt is cut-split and beaten back, perhaps to prevent a wooden handle from slipping.

r celt, Ahar, Rajasthan [After Fig. 7.2 in DP Agrawal, 2000]

Banas culture is marked by painted Black and Red ware (Ahar, Gilund and Kayatha in southeast Rajasthan). At Ahar only copper was used. Five axes, one knife blade, one sheet, a bangle and two rings of copper hav ebeen found. A chopper (paras'u) from Ahar resembles a curved blade from the pre-mature Harappan levels at Kalibangan and resembles the modern **gan.d.asa** of frequent use in NW Bha_rata to cut stalks of wheat, barley and rice plants as well as thick grass. This **kurad.a** hoard from a site called Kurada, Dist. Nagaur, Rajasthan had about 20 such copper blades. Agrawala notes three copper arrow-heads with two holes each, from 2800-2000 BCE levels at Bagore, Bhilwara dist. Rajasthan. A similar arrow-head has been excavated at Indore, Madhya Pradesh.

Ganeshwar Culture

"More than 5,000 artefacts have been reported from a small area. In 1977 Agrawala located a Copper Age site at Ganeshwar (RC Agrawala, 1978, Copper celts and an Indus arrow-head from Khulhade-ka Johad, Dist. Sikar, Rajasthan, *Man and Environment* 2: 123-24) about 15 km south west of Nim-ka-

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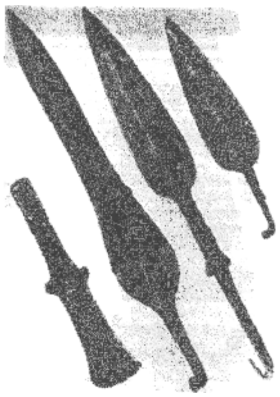
Thana, a tehsil headquarter in district Sikar, 75 km from the actual Khetri copper deposits of Ahirwala-Chiplata. Baleshwar and Dariba mines are within 10 to 15 km from Ganeshwar. From this site he discovered some copper arrow-heads (without any holes) and a spearhead (RC Agrawala, 1984, Ganeshwar Culture—a review, *Journal of the Oriental Institute, Baroda* 34 (1-2): 89-95)…copper objects about a thousand in number. These include 60 flat celts, more than 400 arrow-heads, 50 fish-hooks, dozens of blades, spearheads, rods, nails, bangles, chisels…all of which belong to the Indus typology and not a single specimen is of the Copper Hoards type of the ganga-Yamuna Doab. The use of fish-hooks and arrow-heads suggests that the economy of the Ganeshwar people was still largely dependent on fishing and hunting. The beginning of Ganeshwar culture, on the basis of pottery analysis, may well be pushed back to 3000-2800 BCE…The copper celts from Ganeshwar measure 20 to 25 cm in length and weigh between 1 and 1.5 kg. **Most of them have round indentation marks on one side.** It is perhaps significant to note that the indentation marks on the Ganeshwar celts are near the butt end whereas those on the Chalcolithic celts from Kayatha and Navdatoli in Madhya Pradesh are on the body of the celt, much below the butt end…It is likely that the Kurada celts with four marks were prepared in the Ganeshwar region…It is to be noted that Kurada was situated on a trade route which runs west via Ganeshwar, Kurada-Pokaran-Phalodi-Jaisalmer-Kot Diji…Copper celts and inverted V-shaped arrow-heads occur in the pre-Harappan levels at Kalibangan as well, a fact which suggests their supply from the Ganeshwar-Khetri region. The Ganeshwar type of arrow-heads are available from the Harappan levels at Banawali, in Haryana, as well…The average weight of a Ganeshwar celt is approximately 1 to 1.5 kilograms. All these flat celts were prepared from moulds by the cire perdue technique. **The butt portion of the celts has round indentations in groups of four, five, six, eight, nine, 12** and as many as 15 different combinations of one, two, three, four and six dots. The varied permutations and combinations of dots recall somewhat similar marks on the Chalcolithic celts from Navdatoli and Kayatha (Ansari and Dhavalikar 1975: 150)…Ganeshwar Complex seems to have played a pivotal role in supplying copper artifacts and ingots to the Harappans and the Banasians…" [DP Agrawal, 2000, pp. 108-101]. Ganeshwar is close to one of the streams of the river Kantli which is at places 2 to 3 km. Wide and the river must have facilitated movement or copper ores and artifacts, from Ganeshwar to Kaliban and other SSVC centers along the River Sarasvati and also to reach up to the sites on the Drishadvati such as Siswal, Sherpura and Sothi.

Copper trunnion celt from the Kurram valley, North-West Frontier Province, India. [After Fig. 1 in Robert Heine-Geldern, 1937].



Weapons and trunnion celt of bronze or copper from Tureng Tepe, near Astarabad. A closely related trunnion celt was found at Tureng Tepe near Astarabad, c. 12th cent. BCE. [After Fig. 9 in Robert Heine-Geldern, 1937]. Somewhat similar to the lugged shoulder-axe is the trunnion axe. "About twenty years ago in the valley of the Kurram, a tributary of the Indus, near the Afghan frontier, a copper trunnion celt was found, the only one ever discovered in India, through trunnion celts are rather frequen tin the ancient Near East and in Europe.. [An edged imjplement alsoof bronze or stone, occasionally iron, having a lug (trunnion) on each side for fastening securely]." Trunnion celts are found in Georgia dated to the 12th cent. BCE, a date much later than the Lothal and Nepal finds of lugged shoulder-axes. [Robert Heine-Geldern, 1937, New light on the Aryan migration to India, in: *Bulletin of the American Institute for Iranian Art and Archaeology*,Vol. V, June 1937, New York].

Harita_la, harita_laka = a pigeon, *Columba Hurriyals* (Skt.)
Harita_la = the blade of a sword (Skt.)

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Harita_la, harita_laka = yellow orpiment or sulphuret of arsenic (Skt.) ta_laka_bha = orpiment-like, green (Skt.)

a_la = yellow arsenic, orpiment (Skt.) a_la = name of an ape (Skt.)
ala = yellow orpiment (Skt.)
ala = the sting in the tail of a scorpion (or a bee)(Skt.)
bida_laka = the eyeball (Skt.)
bida_laka = yellow orpiment (Skt.)

"Only the presence of arsenic/arsenic-rich minerals is attested to and includes a piece of yellow arsenic (**hartal**) in Sq K 12/14, Mound F (Vats 1940: 80) and a small lump of lollingite found in 'jar 277'…The several pieces and bits of slag found at Harappa are in general contextually associated with post-cremation urns (cf. N. Lahiri, 1990, Harappa as a center of trade and trade routes: a case study of the resource-use, resource-access and lines of communication in the Indus civilization, *Indian Economic and Social History Review* 27(4): 405-44: 413) and not with metalworking or furnace remains. The evidence for secondary manufacture is as follows: (i) Crucibles: a shallow earthenware crucible, oval at the base and with straight sides (Sq P24/9, Mound AB; Vats 1940: 150) and a fragmentary earthenware crucible found in Mound F, near a furnace 'whose contents show that it was used for melting bronze' (Vats 1940: 471, note1). (ii) Unfinished and unworked objects: the most important examples are from 'jar 277'…In addition, attention may be drawn to the numerous pieces of copper weighing about 2 lbs. (Sq Q24/3 and 4, Mound AB). (iii) Furnaces and metalworking areas: Vats considered the possibility of metalworking being done in a number of furnaces which were discovered in Mound F. These furnaces showed three types. There is a pottery jar furnace, three-fourths of which is embedded in the ground, showing contact with fire. Two cylindrical pits dug in the ground have been found with evidence of fairly intense firing. One of them, furnace Fa, is 3ft 4 inches in diameter, with a depth of 3 ft 8 inches. There is evidence of slanting flue, which served as an air channel for the furnace. A part of the vaulted roof of the furnace was also found lying inside it, and there were flues in this vaulted roof probably as outlets for smoke or as gaps to be covered when the heat had to be conserved. Thirdly, there are 13 pear-shaped pits dug in the ground, often with a column. According to Vats (1940: 470-74) these were used for metalcrafting.' (Chakrabarti and Lahiri 1996: 50)" [DP Agrawal, 2000, p. 75-].

Mehrgarh "A lengthy prehistoric sequence has been established at the important site of Mehrgarh in Pakistani Baluchistan, where an aceramic occupation beginning around 7000 BCE that formed the foundation for the later ceramic Neolithis and Chalcolithic cultures in the region has recently been documented. Despite innovations and changes in the prehistoric sequence of the greater Indus Valley, there is an essential thread of unity and a strong stamp of cultural identity throughout that underscores the essentially indigenous, deeply rooted nature of Indian civilization. While points of contact with other regions are attested, they can hardly have accounted for the strength and individuality of civilization in the subcontinent." (Potts, 1995, p. 1457).

Mehrgarh (Jarrige, 1984, Chronology of the Earlier Periods of the Greater Indus as seen from Mehrgarh, Pakistan, in *South Asian Archaeology*, ed. by B. Allchin, Cambridge, pp. 21-28) in the northern region of Kachhi plains, at the foot of Bolan pass in Baluchistan, has recorded a continuous cultural sequence from neolithic thru chalcolithic (turquoise workshop, 1st half 4th millennium B.C.) to bronze-age cultures, dated from 7th-6th millennium B.C. (a copper bead, sea-shell belt) to 2500 B.C. (spiral-headed copper/bronze pin, one flat axe, one chisel, **pipal** leaves painted on red ware). Crucibles used for melting copper were found in the first half of the 4th millennium. The dates of Mehrgarh are earlier than the Iranian sites of Tepe Yahya and Tal-i-Iblis, thus recording a paradigm change and 'a collapse of the earlier Irano-centric view' of diffusion of chalcolithic

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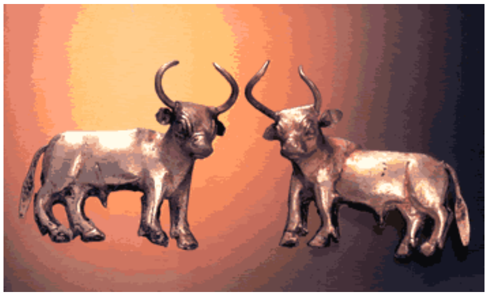
cultures from Iran to the Sindhu-Sarasvati valleys (Asthana, 1985, *Pre-Harappan cultures of India and the Borderlands, Delhi, Books and Books*: 16-82).

Quetta. Gold pendants shaped like bulls and vase decorated with lion glyph were some of the the



finds of the gold hoard from Quetta tombs, dated to the beginning of second millennium BCE. Also found were gold necklaces, carnelian and chalcedony pendants rimmed with gold. These are cited as examples of influences from Baluchistan, northern Iran and Turkmenistan after the post-Harappan phases of Sarasvati Civilization.

Mundigak, near Kandahar in southern Afghanistan has yielded a flat blade, a bronze point or punch with a circular cross-section (6th millennium B.C.); a lance-head, a knife, sickles and chisels, mirrors, double-spiral-headed pins and a buckle (ca. mid-4th millennium B.C.)
Damb Sada_t, west of Quetta yielded clay seals, copper dagger and knife (3630-2630 B.C.)

Balakot, 88 kms. NW of Karachi yielded copper-bronze objects, native lead and a shell-bangle workshop (mature Harappan phase).

Kot Diji, 25 km. south of Khairpur on the left bank of Indus. Fine axe, chisels of copper, some bronze bangles, knife blades, arrowheads, beads and shell-bangles.

Antelope motif and two signs of script. Chanhujo-daro. Joint expedition of the American School of Indic and Iranian Studies and the Museum of Fine Arts, 1935-1936, Museum of Fine Arts, Boston. The forward-arching horns are not known to occur on any such South Asian antelope or gazell. A standard device is placed in front of the figure. Hardened steatite. Cf. Mackay, 1943, pl. LI, 21 [After JM Kenoyer, 1998, p. 191]. These and other pre-Harppan sites right and left banks of the Sindhu river seem to predicate a Sindhu-centric view of the evolution, for nearly 5 millennia, of cultural sequences from ca. 8th millennium BCE. There are indications of a pre-Harappan culture in Rajasthan.

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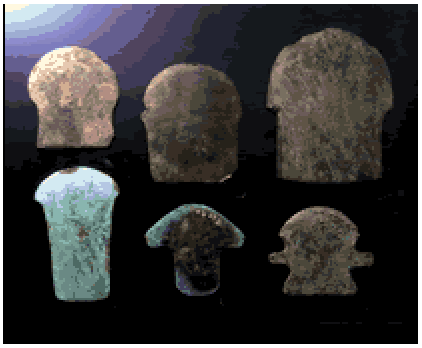
Lothal. Ivory scale with divisions measuring on an average 1.704 mm.

Bagor located on the left-bank of Kothari river and 25 km. west of Bilwara in eastern Rajasthan had a microlith industry (5000-2800 B.C.)(Sankalia, 1974, *The Pre-history and Proto-history of India and Pakistan*, Pune, Deccan College, 260-64); the chalcolithic phase at this side yielded bits of copper/bronze, one spearhead, one thin rod and three arrowheads (ca. 2800 B.C.) **Jodhpura** located on the right bank of river Sabi, near Jaipur and Ganeshwar, 15 km. from Neem-ka-Thana (37.40N and 75.51E) yielded over 1000 copper objects (ca. 2500 B.C.): arrowheads, spearheads, fish-hooks, spiral-headed pins, celts, thin blades, bangles, chisels. Axes were cast in mould and edges bevelled by hot and cold forging. There is a place near **Ganeshwar** called Kulha_d.e-ka_-Johad. (pond of axes). Round indentations made with pointed copper drills, in combinations of 1-6 dots, totalling between 4-16 were noticed on the butt of the celts, indicating some ancient system of numeration. Similar indentations wre noted in later-day celts found at Kayatha and Navdatoli. Kantali river was close to these sites and this river linked up with the Sarasvati near Kalibangan. A copper hoard was found at Kurada (Nagaur district): 55 rings, 21 curved thin blade or choppers, 11 chisels, 9 bowls, 7 celts. (Agrawala, R.C.,1984, Aravalli, the major source of copper for the Indus and Indus-related cultures, in *Frontiers of the Indus Civilization*, eds. B.B.Lal, S.P. Gupta and Shashi Asthana, Delhi, Books and Books, pp. 157-62). Very heavy copper implements such as celts, harpoons, anthropomorph, double axe and antennae sword of the Copper Hoard culture (circa 1500 to 1000 BCE) are related to the Ochre Coloured Pottery (OCP) sites. The purity of copper of a high degree and it is surmised that the copper mineral resources were obtained from the Lakker mines in Chota Nagpur range of mountains. Some of the shapes of these copper objects indicate the influence of metallurgical technology of Sarasvati civilization indicating cultural continuity of the metallurgical tradition.



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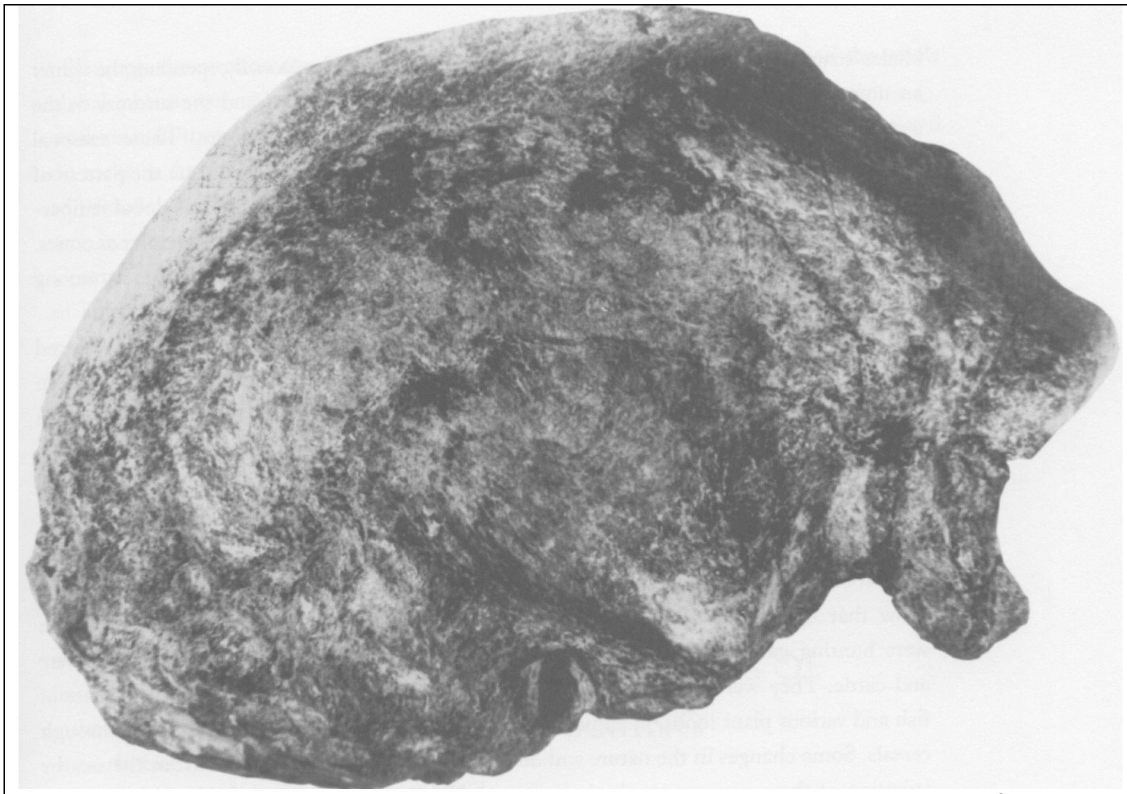

Narmada skull discovered in north central Bharat. Over 300,00 years Before Present. Associated with Acheulean stone tools. (After Kenneth AR Kennedy, 1982, ‘Skulls, Aryans and Flowing Drains: the Interface of Archaeology and Skeletal Biology in the Study of the Harappan Civilization’ in: G. Possehl ed., 1982, *Harappan Civilization*, OUP, New Delhi)
The region of the copper hoard finds is not far from the place where the Narmada skull was found.

Sothi (Bikaner), on the banks of Sarasvati and Jalilpur, 78 km. SW of Harappa has yielded copper or bronze rods. Kalibangan (ca. 2900 B.C.), on the left bank of the Sarasvati river also recorded Sothi ware and copper bangles, an axe, a paras'u and over 100 copper artefacts. Pre-Harappan levels of Kalibangan have recorded only three copper objects: a curved blade (chopper), a celt and a bangle (Lal, B.B.,1979, Kalibangan and the Indus Civilization, in: Essays in Indian protohistory, ed. D.P. Agrawal and Dilip Chakravorty, Delhi, BR Publishing Corpn, pp. 65-97) Agrawala (1984), however, reports 56 copper objects: antimony rods, rings, wire pieces, lumps, bangles, pins, arrowheads, beads, rods, celts. The Harappan period extended this repertoire to include: hooks, chisels, spearheads, knives, awls, nails, blades, ear-rings, drills, daggers, needles, razors, mirrors, figures of bulls.

Banawali, 15 km. NW of Fatehabad on the Sarasvati River had a house with several hearths, ovens and fire-pits. There were bangles of copper, shell and faience. Products: arrowhead, bangle, spearhead, sickle blade, razor, chisel, ring, double-spiralled and simple pin, ear/nose ring/fish-hook (R.S. Bisht, 1982, Excavations at Banawali, in: Harappan Civilization, ed. G.L. Possehl, Delhi, Oxford and IBH Publishing Co., pp. 113-24).

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Kalibangan products: celt, hammer, bangle, arrow, fish-hook, axe, paras'u, mirror, pin (B.B. Lal, 1979, Kalibangan and the Indus Civilization, in: *Essays in Indian Proto-History*, eds. D.P. Agarwal and D.K. Chakrabarti, Delhi, B.R. Publishing Corpn., pp. 65-97).

Gamanwala had an extent of 27.3 ha. and **Ganweriwala** of 81.5 ha. (almost as large as Mohenjodaro) and were industrial sites on the banks of the Sarasvati River close to the Cholistan desert. Some sites were specifically for melting and fabrication of copper objects. At **Siddhuwala Ther**, located near Derawar, Sir Aurel Stein had discovered a number of kilns and a copper ingot. (Mughal, M.R., 1982, Karachi, *Archaeological Surveys in Bahawalpur*, Dept. of Archaeology and Museums, Govt. of Pakistan).

Warfare in Mesopotamia

The study of minerals and metals in the extended region of the civilization, during the third millennium BCE, can be related to the evidence for warfare in Mesopotamia, in Sumer, in particular, which did not have indigenous mineral resources and had to draw upon the resources available from the neighbouring regions.

By the Early Dynasty III period, the Mesopotamian craftsmen had mastered the techniques for working copper, lead, silver, gold and tin. The Royal Cemetery at Ur has yielded a corpus of metal work where true tin bronze is found, apart from the common arsenical bronze and precious metals: gold, silver and electrum. Metal blades were produced in many sizes to serve as arrows, spears, daggers. Also found are sickles and hoes. Axes come in many shapes and sizes, some cast and some hammered with the tang beaten round a haft (See the drawing of a Sumerian soldier carrying spear and axe.) (Crawford, H., p. 133). Muhly (1983) quotes a passage from the late third millennium Laws of Eshnunna that a workman issued with tools for the harvest must return the same weight of metal at the end of the season, even if some of it is scrap. This is an indication that temples had metalsmithies where metal could be melted down and recast. Simug was the metalsmith.

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Warfare in Ancient Sumer

Copper tools predominate in Sumer by Ur III period (2380-2360 B.C.) In Sumer, the early urban civilization of southern Mesopotamia, kings used writing to record and commemorate significant military victories.

A warrior, ca. 2500 B.C. with helmet, battle-axe and sickle-sword; a small plaque of engraved shell from the ancient city of Mari on the Euphrates (Musee National de Louvre, Paris)

The standardized equipment of bodyguards were: a copper helmet, battle-axe, the dagger and a heavy spear. The early spearheads had long tangs, which were thrust into the spearshaft. A hook was formed at the end of the tang to firm up the attachment to the shaft. The blade of a Mesopotamian battle-axe was round, designed to pierce helmets and skulls and slash gaping flesh-wounds.

Head of a soldier wearing a helmet fastened with a chin strap. Mari (modern Tell Hariri) Palace. C. 18th cent. BCE. Aleppo Museum. (Jack M. Sasson (ed.), *Civilizations of the Ancient Near East*, p. 889).

"Mari on the Euphrates... The palace administration was responsible for the provision of arms, munitions, and siege equipment. King Zimri-Lim wrote while on a military campaign to order further supplies of arrowheads: 'To Mukannishum [his official in the palace] say this, Thou speaks your lord. When you hear this letter read, have made: 50 arrowheads of 5 shekels [40 grams] weight in bronze, 50 arrowheads of 3 shekels, 100 arrowheads of 2 shekels, 200 arrowheads of 1 shekels. Give orders to have this done at once. Then have them put in store to await my further instructions. I suspect the siege of Andariq will be prolonged. I shall write to you again about these arrowheads. When I do write, have them brought to me as quickly as possible.' Anothe letter from the king to the same official orders him: 'When you hear my letter read to you, have made 1,000 bronze arrowheads at 1/4 shekels [2 grams] each. Have them made from the red bronze at your disposal, and have them sent to me at once.'.. Later, when Shamshi-Adas's son Yasmah-Addu was installed as vice-regent at Mari... in a letter to his son, Shamshi-Adad ordered 10,000 arrowheads to be made, requiring almost five tons of bronze. Some of the bronze for the job had to be transported from Assur since the Mari palace armourers did not have enough stock. The accounts were kept straight Watkins, 1989, The Beginnings of Warfare, in: General Sir John Hackett (ed.), *Warfare in the Ancient World*, London, Sidgwick and Jackson Ltd.)

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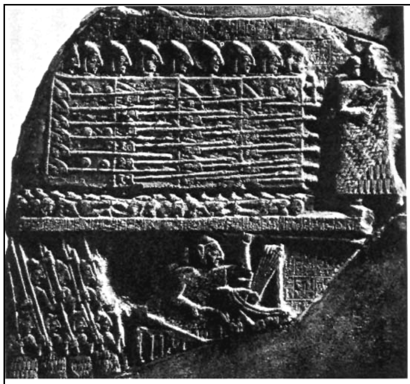
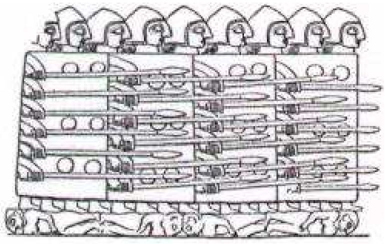
Detail from the 'Ur-Nammmu Stela', found at Ur, showing the King Ur-Nammu (ca. 2112-2095 BCE) officiating at a temple-building ceremony. He caries the tools of a builder: axe, basket, builder's dividers, ladle for bitum mortar, and a flat wooden trowel (after Woolley 1974: pl. 41a; cf. PRS Moorey, 1994, fig. 19, p. 303).

Crescent axe in Egypt of Asiatic origin, Twelfth Dynasty painting.



Vulture-stele (upright monument carved with reliefs and inscriptions) of Eannatum, Patesi of Shirpurla, Lagash leading his troops inbattle and on the march (ca. 2500 B.C.); abandoned bodies are shown being picked by vultures. [Louvre Museum; Dec. en Chald., pl. 3 (bis)]; inscription records his victory over Ummaites and treaty of peace forced upon them; upper register: Ur-Nina, king is of colossal size and is standing; he balances a basket (perhaps containing clay and foundation brick for the temple of Ningirsu) with his right hand; the inscription written alongside mentions the temple of Ningirsu; lower register: the king is raising his cup offering a libation; all figures are clad in Sumerian short woollen skirt, called 'kaunake'.



Phalanx of Sumerian soldiers armed with copper-tipped spears; relief on a stele from Tello, Mesopotamia, 3rd. millennium BCE.

The light infantry wear no protective armour and carry no shields; each holds a long spear in the left hand and a battle-axe in the right. Massed ranks of helmeted spearmen are behind a front rank of men bearing sheilds; these soldiers were trained, uniformed and equipped to fight as corps. The vulture-stele shows that the long lance or spear is grasped by both hands and is the principal weapon of offence. Axe, dart, club or mace, a curved weapon and a short lance were also in use. Eannatum is bearing the curved weapon, a number of double-pointed darts and a long lance; he is in the act of piercing the head of a vanquished foe with his lance, which he holds horizontally over his head at the extreme end.

Baked clay balls, copper arrows, spears, axes and stone clubs were discovered in the pre-Sargonic strata at Nippur.

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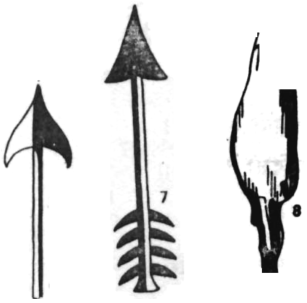
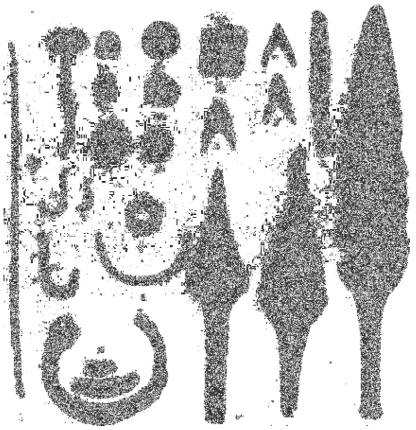
Silver Dagger, Harappa, 2700 BCE. National Museum, New delhi. Two holes near the tang, mid-rib. [After Pl. 19 in Sayed Jafar Mahmud, 1988, Metal technology in Mediaeval India, Delhi, Daya Publishing House].

The most frequently occurring weapons at Mohenjo-daro are: celts, axe-adzes and saws. [EJH Mackay, p. 454].



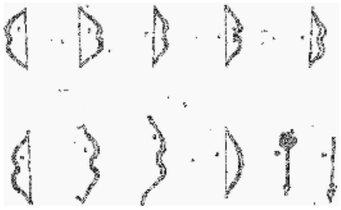


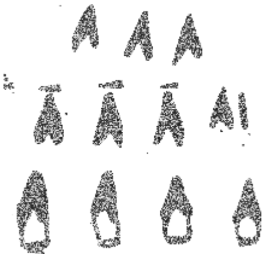
Banawali. Copper and bronze toolsweapons and ornaments. Harappa period. [After Fig. 4 in R.S. Bisht and S. Asthana Recently excavated Harappan sites in: Maurizio Taddeo 1979 South Asian Archaeology 1977 Naples].

Arrow-heads

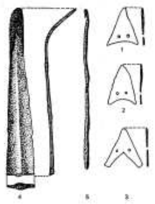
Arrows as shown in: Punch-marked coin; Tribal coin; Taxila excavation. [After Fig. 141, Nos. 6,7,8 in: GN Pant, 1978].

Bows and arrows as depicted in Gupta coins [After Vidya Prakash, 1967, *Khajuraho*, Bombay].





SSVC Arrow-heads. Thin copper pieces, narrow barbs without tang. 1.19 in. long, .64 in. wide and .07 in. thick. The arrowheads are inserted into bamboo-splits or wooden shafts. [After Fig. 79, GN Pant, 1978].



"The bow and arrow are simple weapons having a continuity right from the prehistoric times. It is quite probable that being the cheapest and easily available weapon it was popular and was found in the smaller houses (of DK Area) which were in all probability in occupation of soldiers and the

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people of similar status…Mackay observes that the tie-holes were made for this purpose in arrow-heads of almost identical form from Zafer Papoura, Crete. (Hall, Aegean Archaeology, p. 251). The bronze arrow-heads found at Mycenae have three tie-holes for fixing it to the shaft. (Wace, Archaeologia, Vol. LXXXII, p. 59). But these are of later date…The average length of the 'Indus' arrow-head is 1.19 inches, breadh 0.64 inches and thickness 0.07 inches. All these are, more or less, of one type. While a few stone arrow-heads have been found at Harappa, no such specimen is known from Mohenjo-daro…The majority of the tools is of copper." (GN Pant, 1978, p. 35).

Arrowheads from Banawali (Rajasthan). The larger example resembles those from Ganeshwar. About 400 arrowheads were discovered in Ganeshwar with about 1 percent arsenic content. 2. Copper objects from Bagore (Rajasthan). Period II (2800-2000 BCE) which were provided with two holes each to be fixed to a wooden shaft using a thin wire. Ganeshwar variety of arrowheads were found in negligible numbers at Kalibangan, Lothal, Harappa, Mohenjodaro and Chanhudaro (Marshall 1931: Pl. CXLII, no.13; Mackay 1938: Pls. CXXI, CXXVII,CXXXIII; Vats 1940: 383-84, Pl. CXXV, nos. 13-14).

[After Fig. 11.2 and 11.3 in: RC Agrawala and Vijay Kumar, Ganeshwar-Jodhpura Culture: New traits in Indian Archaeology in: GL Possehl, opcit., 1982].

Knives and daggers

"It is difficult to discriminate between knives and daggers. Most of these specimens unearthed might have served both the purposes, like the mediaeval European dagger which was used for cutting meat at the dining-table and also for killing an enemy in the field." (GN Pant, 1978, p. 36). Mackay has grouped the knives under the following headings (Mackay, p. 462):

Broad leaf-shaped blade (Pl. CXV 11; CXVII 9; CXIX 5; CXX 4,5,10,11). This type has been found in good numbers. The blade is broad, leaf-shaped, double-edged and long. Except one (No. 5, Pl. CXX of Mackay), which is of bronze, all others are made of copper (Pls. CXIII6; CXXVII 4; CXXIX 8; CXXXIII 21, 24,28). In some examples, a copper strip is wrapped round the short tang to thicken the tang.

Leaf-shaped blades with curved tips. A few specimens of copper have been found at Harappa. (*Annual Report of the Archaeological Survey of India*, *1926-27*, Pl. XXII 4-5).

Narrow, straight knives (Mackay, Pl. CXIX 2; CXX 8,12,25; CXXX 19,20,23,24). Small copper knives with narrow edges and blades show signs of repeated sharpening. The longest of this type is about 5 inches long.

Mohenjo-daro. Knife with a re-curved point Principally a cutting weapon, perhaps used for cutting fine leather. [After EJH Mackay]. Triangular knives with upturned points (Mackay, Pl. CXX 22,23; CXXII 4,5). One knife has been found at Harappa (*Annual Report of the Archaeological Survey of India*, *1926-27*, Pl. XXII 12). and two at Mohenjo-daro. A similar knife has been found at Egypt (Petrie, *Tools and Weapons*, Pl. XXIV 23).

Narrow curved-edged knives (Mackay, Pl. CXIX 3; CXX 24; CXXII 2,3; CXXX 22,27). Five copper knives found at Mohenjo-daro.

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Holl-backed knives (Mackay, Pl. CXX 13; CXXII 11). Only one specimen of copper found at Mohenjo-daro. Thick concave back sharpens towards the convex edge.

Double curved knife (Mackay, Pl. CXX 14). Only one specimen found at Mohenjo daro.

Broad curved-edged knives (Mackay, Pls. CXIX 3; CXX 16; CXXX 28). Three copper knives at Mohenjodaro with tangs riveted to the blade. A fragment of wooden handle stick to the tang with three rivets set in a triangle is seen in Mackay Pl. CXXX 23. The piece of wood was split to insert the tang and a portion of the blade. The commonly used wood for such handles is of *dalbergia sissoo* (called yali_).

Ebony: s'almali wood used to make chariot-wheels (RV. x.85.20)(Vedic.lex.) s'a_la the tree vatica robusta or shorea robusta (MBh.); sa_la shorea robusta (Pali.Pkt.); sa_l (P.N.B.H.M.); xa_l (A.); sa_l.a (Or.); sal, hal the tree vateria acuminata (Si.)(CDIAL 12412). ca_lam sal; Ceylon ebony; tree (Ta.lex.) yamakasa_la_ pl. the two sa_l trees between which Buddha died (Pali); imal pair of sa_l trees (Si.)(CDIAL 10423). cf. karumaram shorea robusta, ebony (Ma.)(DEDR 1282). cf. tumpi Ceylon ebony, diospyros tomentosa (Ta.)(DEDR 3329). cf. ke_ndu a kind of ebony, diospyros embryopteris (SKt.)(CDIAL 3464). Vatica robusta: ca_lam Ceylon ebony; ca_li id. (Ce_tupu. Ce_tuvan. 9)(Ta.lex.)

Shorea robusta: Gudea of Lagash, a Mesopotamian ruler seems to have imported from Magan (perhaps Makran, southern Iran and the Gulf): timber, haluppu wood (ha-lu-ub = tatitu, haluppu, eastern species of oak), musukannu (mis-ma kan. na) or mesu wood, makkanu (^{gis}gis'immar), 'magan reed' (bamboo), magan onion (? or garlic or asafoetida which grows in the Kerman region) (sum.sar.ma.gan^{ki}), diorite (na.esi = us'u_; an alternative interpretation is that gis'.es'u may be a wood resembling diorite, and therefore hard and black, perhapys ebony), red ochre, carnelian, semi-precious stones, often beads... haluppu wood was not a wood used for ship-building, but for furniture, chariots, buildings. Mesu wood was used for vehicles and furniture... this is called yaka_ by Darius ('came from Gandara and Karmana) and ^{gis}s'e-i; dalbergia sissoo (used for ceiling rafters at Mohenjo-daro, boats and agricultural implements) is called yax or jag in Kerman (cf. yaka_ old Persian) (Shereen Ratnagar, Encounters, the Westerly trade of the Harappa Civilization, Delhi, OUP, 1981, pp. 39-41; pp.104-105; Gershevitch, I., 'Sisso at Susa', Bulletin of the School of Oriental and African Studies, 19: 317-20, 1957). Semant. hal (Si.)(CDIAL 12412) and haluppu wood imported into Mesopotamia by Gudea of Lagash. sa_l the tree shorea robusta, vatica robusta (dipterocarpaceae) found in the west of the Jammu river, in the Siwalik region below Kangra. The timber is hard, heavy and durable, and is one of the best possible for all purposes where great strength is required and weight is no objection. The resin (ra_l zard) which exudes from the tree is used medicinally and in the arts; a kind of sugar press used in the Simla hills (Punjabi.lex)

Varieties of daggers found

Knife-cum-daggers. Specimens which could have been used both for thrusting and cutting.

Shoulder daggers with abrupt shoulders. Most of these are made of bronze and were not riveted to handles.

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Daggers with mid-rib. A sharp tang might have been used to insert it into the handle. Daggers with mid-ribs have been found at later levels.

Narrow double-edged daggers. Found at earlier levels.

Razors

Razors of four types are known, the common types are with a long handle.

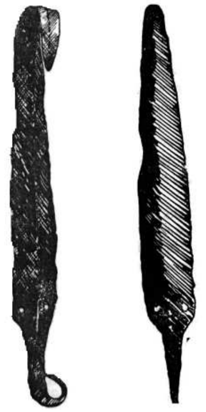
Saws

Lothal. Circular saw (bronze). [After Pl. LX-A in SR Rao].

The cutting edge of saws is semi-circular and serrated. Flaked stone celts upto ten inches long might have been used for cutting. Ribbon-flakes of chert separated from prepared cores have also been discovered.

Swords

Mohenjo-daro. Incscribed blade (of sword?)



Left: Dirk from Hardoi; Right: Dirk from Mohenjo-daro. The two holes at the bottom are for hafting to the shaft. [After Fig. 81 GN Pant, 1978]. A handle of stag's horn, four inches long and one inch dia has been discovered. It is likely that this was used as a hilt for a dagger.

The axial center of the casting is thick to constitute the mid-rib of the finished weapon after hammering. Two pottery-models of shaft-hole axes from Mohenjo-daro and a bronze specimen from Chanhujo-daro indicate that the weapons were hafted onto wooden or bamboo handles.

> "These swords are double-edged and indicate an advanced craftsmanship. They are well shaped and heavy for their sizes. Most of these are in a good state of preservation. One figured as No. 3 in Pl. CXIII of Mackay [EJH Mackay, 1938, Further Excavations at Mohenjo-daro, Vol. I, New Delhi, p. 467 (cf. Pl. CXVIII 9), is a long, narrow, copper weapon found in a hoard. It measures 15.75 inches in length and its maximum thickness is 0.4 inches. There are two rivet holes at the junction of the tang and the blade. The tang is rectangular and its thickest part is 0.65 inches wide. The blunt edges and point of the blade would suggest that it was unfinished. Another piece (No. 9 in Pl. CXIX of the same hoard) (cf. Pl. CXX 17) is of copper and 18.5 inches long and 0.48 inches thick at the junction of the blade and tang. Its point is not sharp. The two rivet holes, slightly chamfered pierce the blade close to the tang. A stout medial-rib runs down the blade on both sides. It is not very heavy and weighs only 1 ½ pounds. It was perhaps used for slashing and not for thrusting. A broken copper casting No. 5 in Pl. CXXVIII of Mackay [Cf. Pl. CXXI 19) is 3.2 inches long, 1.21 inches wide and 0.22 inches thick. It appears to be the point of an unfinished sword. Thus, these three, along with another of similar type with a slight median thickening and diamond-shaped section, represent short swords or dirks. 'We have no evidence that either of these weapons was an importation, indeed it would be difficult to say whence it could have come, for nothing of the kind has yet been found at Elam at this early period and only one example is reported from Sumer, at Telloh whose blade and hilt measure a

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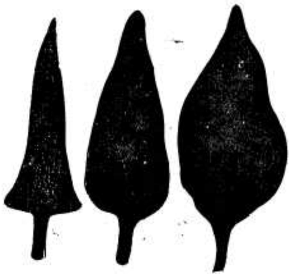
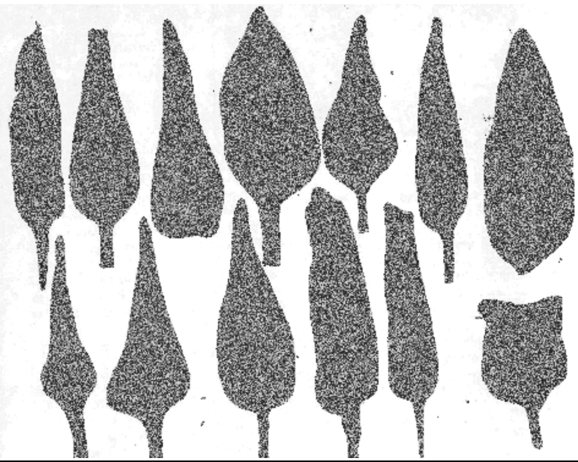
trifle over 16 ¾ inches long (Heuzey, *Descouvertes en Chaldee*, Vol. 1, p. 386). Swords are just as rare in Egypt as they are in Sumer, and a weapon of very similar shape to our second specimen found in Egypt, but of much later date, is regarded as an importation from either Syria (Flinders Petrie, *Tools and Weapons*, Pl. XXXIV, fig. 40) or Cyprus.' (EJH Mackay, p. 467).

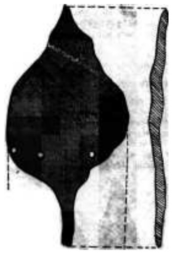
"A similar sword has lately been discovered by Flinders Petrie at Tell el Ajjul in Southern Palestine (Flinders Petrie, 1931 *Ancient Egypt*, 1931: p. 38, fig. 4) which is made of copper but is more tapering in shape. It has been dated to the Sixth Dynasty of Egypt. Mackay has rightly observed, 'Thus in India, Sumer and Palestine the short sword was used as early as or before 2500 BCE, but to what country its invention should be ascribed is, at present, very uncertain.' (EJH Mackay, p. 467). In view, however, of the great probability that the sword was derived from the dagger, it might easily have been invented in each of these countries independently." [GN Pant, 1978, pp. 33-35].

Lance-heads



Mohenjo-daro. Lance heads. Left: A repeatedly sharpene3d lance-head has become short and almost looks like a knife blade (Pl. CXVII 9). A long, bronze spearhead comes from SD area, measures 15.3 in. long, 4.8 in. wide and .15 in. thick. [After EJH Mackay; Pls. CXX 1-3; CXXIII, 2,3,5,8; CXXIX 3,5]. Another lance-head 10 in. long 2 in. wide and .13 in. thick has been found without tie-holes. (Pl. LXXI.33; CXIII 7; CXVII 8,11; CXX 7,9]





Leaf-shaped lance-head with two holes near the tang for hafting [After Pl. CXVII, 11 in: Mackay] The lance-heads are comparable to spear-heads but are so called because of the smaller size of blades. The average length is 3 to 4 inc. They are made of copper, double-edged and pointed.

Spear-heads

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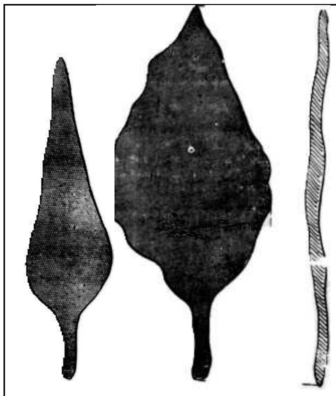


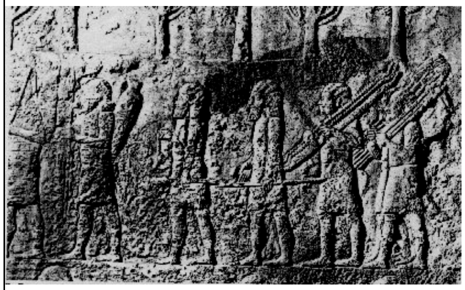
Inscribed spear-head. Some weapons found at Mohenjo-daro are bronze with a substantial percentage of tin content to make the weapons hard. The discovery of an open hearth with charcoal at Mohenjo-daro indicates that copper was smelted at this site; a quantity of ore and ingots have been found at the site. There is a possibility that the metal-workers of Mohenjo-daro obtained the copper and tin ingots for manufacturing the alloyed weapons and tools.

Leaf-shaped spear-heads without holes. [After Mackay]. The broad blade may also have served as a sword for slashing. The absence of a mid-rib is notable in these specimens. There are no holes and samples 3 to 5 have tangs which might have been inserted and tied into shafts or bamboo-splits.

Top row: 1. Arrow-head type; 2. leaf-shaped with point missing; 3. leaf-shaped with tang missing; 4. broad leaf-shaped; 5. leaf-shaped; 6. upper-half missing; 7. tapering towards the end.
Bottom row: 8. pointed; double corners; 10. longest spear-head from SD area (15.3 in. long); 11. a long spear-head; 12. damaged spear-head; 13. damaged spear-head.

Axes

Two types of blade axes or celts have been found: long and narrow; short and broad. Most of these types are also found in the Middle and Near East. Stone prototypes of both types are common in Northern and Central India. (John Marshall, Vol. I, p. 35). It is possible that some of these were also used as adzes.



Adze. Old Babylonian terracottaplaque showing a woodworker using an adze to make a table leg. The earliest representation of a near eastern cabinetmaker. The leg curves at the bottom and ends in a decorative foot, shown braced by the cabinetmaker's toes as he works with the heavy adze. The cabinetmaker sits on a stool. Louvre Museum, Paris. [After Fig. 8 in: Jack M. Sasson (ed.), *Civilizations of the Ancient Near East*, p. 1653]. ca. 1900 1700 BC; 8 X 7.6 cm. (After Fig. 1 in PRS Moorey, 1994, p. 201).

Fragment of a Mosul Marble relief of the time of Sennacherib showing workmen with iron (?) saws, shovels (or spades), and pickaxes; from a scene of quarrying (After Fig. III B in: PRS Moorey, 1994).

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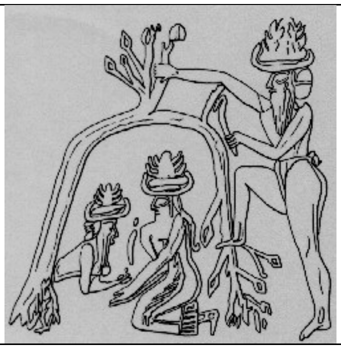
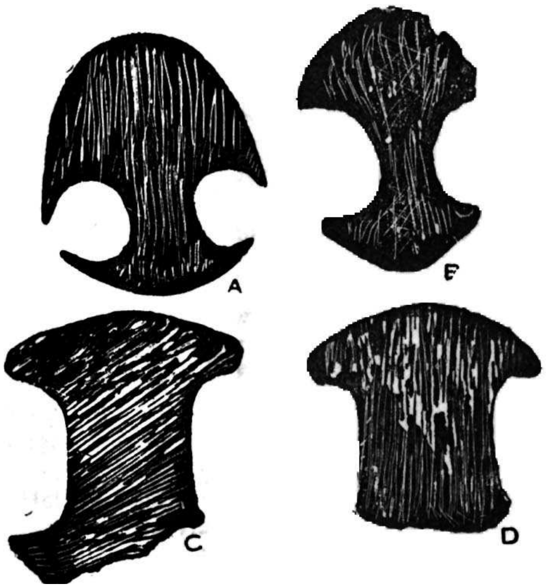
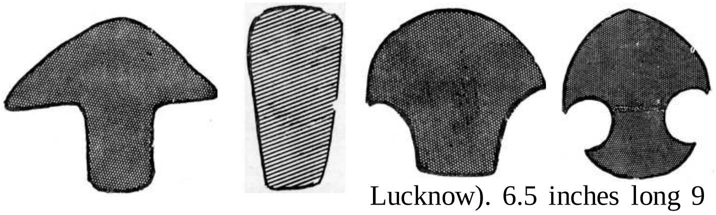


Detal from a scene carved on an Akkadian cylinder seal (ca. 2350 2100 BCE) showing a deity using an adze to trim or cut a tree (after Tallon 1987: i, fig. 17; cf. PRS Moorey, 1994, fig. 24, p. 354).



Working end of the axes has a crescent shape and is double-convex. The butt is either straight or slightly rounded.
In specimens C and D, the edges are splayed.
A.: Double-edgged axe, deeply curved, Bhagarapir, Orissa
B. Double-edged axe, less curved, Bhagarapir, Orissa.
C. Double-edged axe from Harappa.
D. Double-edged axe from Harappa.
[After S.P. Gupta, 1963, The copper hoards: the problems of homogeneity, stages and development, origin, authorship and dating, *Journal of the Bihar Research Society*, Vol. 49, Patna, pp. 1-7].



Axe specimens from: Sarthauli; Gungeria; Dunria; Gungeria. [After Figs. 130 to 133 in GN Pant 1978]. From Left: The axe from Sarthauli is perhaps a paras'u (State Museum Lucknow). 6.5 inches long 9 inches wide (BB Lal1951 p. 29 Pl. VIIB 1 figs. 4 6). Battle –axe; 18.5 in. long 15.75 in. wide. The shapes are comparable to those found in Harappa.

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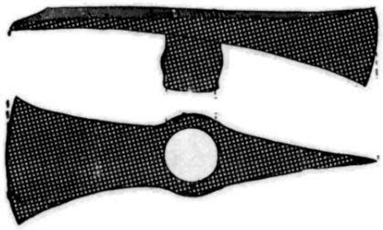
Mohenjo daro. Shaft hole adze axe. [After BB Lal, 1951, Further copper hoards from the Ganga Basin and a review of the problem, *Ancient India*, No. 9 (January, 1951), pp. 20 39]. The adze axe occurs at Hissar IIIC and Turang tepe between 1200 and 1000 BCE. (Heine Geldern, 1936, pp. 94 98).

Shaft-hole copper axe; comparable to flat types from Gungeria. Shahi-tump (Peshawar Museum). [After J.Coggin Brown, *Annual Report of the Archaeological Survey of India (93-4)*, p. 247, Pl. LXVIIC; cf. p. 246, Pl. LXVIIB]. This 'Kurram axe' is said to have parallels in the Mediterranean, Transcaucasia and Iran (c. 200 to
000 BCE).

Mohenjo-daro. Two views of a socketed axe-adze.

0.5 in. long. A projecting socket .7 in. dia. Horizontal blade is 2.52 in. wide and the axe-blade 3.5 in. wide. [John Marshall, 93 , *MIC*, Vol. III, Pl. CXXXVIII, 6].



Mace-heads

Mace-heads were made of stone and stone (alabaster, sandstone, cherty limestone and green-coloured stone). Copper mace-heads have been found at Harappa where the pear-shaped mace-head was common. A copper or bronze mace-head has also been found at Chanhujo-daro in a late Harappan context. Some types were lentoid and circular. An hour-glass type of perforation is made at both ends of the mace-heads to be lashed to leather thongs. Mortimer Wheeler noted that similar maces were found at Susa, Egypt, Caucasus and in pre-historic Europe. (Mortimer Wheeler, 1968, *The Cambridge History of India*, Suppl. Vol., p. 76).

Missiles

Three types of missiles were found at the foot of the citadel at Harappa; about 98 pieces were discovered from the parapet of the tower. A large hoard of potter balls were reported from the area south of this location. (John Marshall, 1931, Vol. II, pp. 465-467):

Clay (perhaps sling-) pellets (round or ovoid) about an inch dia., 2 to 2 ½ in. long
Lumps of clay compressed and baked weighing about six oz.
Lumps of clay baked weighing about 12 oz.

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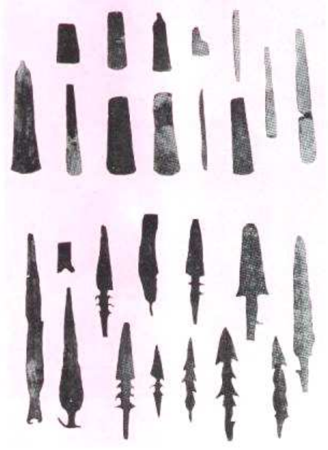
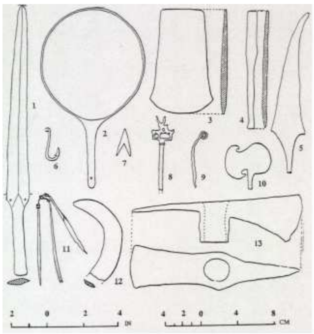
Armour

"Several small domed pieces of copper, each perforated with two holes, have been found…Thesse were perhaps sewn on to a garment and used as a coat of mail. (John Marshall, Vol. II, p. 533; Vol. III, Pl. CXLIII; Mackay, pp. 54, 19; Pl. CXL 54,66). In the National Museum, New Delhi several such pieces, belonging to the 16th-17th century AD, stitched together on a cotton tunic to form a body armour, are preserved. But no other evidence of body armour or helmet has been traced. Shields, too, are unknown although certain pictographs in the Harappan in the Harappan seals may represent men holding shields." (GN Pant, 1978, p. 40).

Harappan civilization: copper/bronze tools: flat axes with splayed out sharp edge, straight-ended chisels, sickles, knives with a curved end, straight and curved saws, planer-bits, drills, awls, arrowheads, spearheads, curved fish-hooks with a loop at one end and a sharp conical projection at the other, curved-in razors, circular mirrors with a tang perhaps inserted into an ivory handle, hairpins with single-or double-spiral heads needles (some with the eye near the pointed end), nails, chains. Late Harappan level of Chanhudaro yielded an axe with a shaft hole (two models of this type in clay are seen in Mohenjodaro); one example of an axe combined with an adze with a shaft hole has been found in a late level in Mohenjodaro.

Copper-bronze artefacts from Mohenjodaro exhibited at the Mohenjodaro museum (Dr. Abdul Jabbar Junejo and Mohammad Qasim Bughio, 1988, Cultural Heritage of Sind, International Arabi Conference, University of Sind, Hyderabad, Sindhi Adabi Board); out of 13 artefacts analysed. 6 were found to contain between 4.51% to 13.21% tin; the artefacts were: bronze rod, bronze button, bronze chisel, bronze slab, bronze chisel and bronze lump.

Copper bronze objects from mature levels of Kalibangan.		
		

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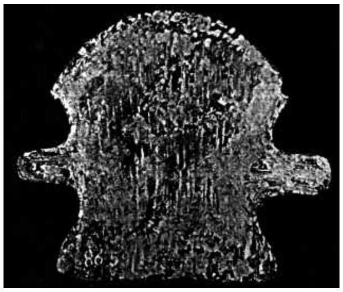
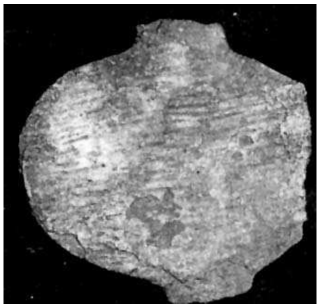
Lothal. Shoulder-axe (copper/bronze) [After Pl. LXI in SR Rao].





Lugged shoulder-axe, Sitapur. Copper. National Museum, New Delhi.

"The lugged shouldered axes described and illustrated here represent a different variety among the axes generally found in the Copper Hoards…with concave or straight edges. It has a prominent elliptical or convex sharp working edge with a straight sided butt-end…The weapon is characterized by one pair of lugs projecting from the center of the two sides. The lugs were meant to facilitate hafting…Axes of this atype were reported from Kathmandu Valley in Nepal, the Kanpur-Unnao border region, Lothal (referred to as an anthropomorphic figure—dated c. 1900 BCE) and in Rewari, Haryana (dated c. 2900 BCE) (R. Yule, 1982, Metal work of the bronze age in India, Munich)." [DP Sharma, 1998, Two unique lugged shouldered copper axes from the National Museum of India Collection, in: Vibha Tripathi, ed., *Archaeometallurgy in India*, Delhi, Sharada Publishing House, pp. 292-296].

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Furnaces (kilns) for stoneware bangles (with epigraphs), ceramics and metals

"The oldest high-fired stoneware ceramics in the world were crafted by the Indus artisans into a standard ornament worn as a bangle or possibly carried as a ring of office. Each bangle bore a tiny inscription only visible on careful examination…After careful preparation the four or five bangles with tiny inscriptions were place in a small canister that was stacked with other canisters and plastered with a mixture of clay and straw. A single sign of the Indus script, possibly a sacred symbol to ensure a successful firing was traced on the wet plaster. This stack of canisters was then placed inside a larger jar, covered with clay and sealed with a square stamp seal. Each stage of manufacture and firing appears to have been accompanied by some use of the script, effectively controlling and protecting the production." (J.M. Kenoyer, 2000, opcit., p. 75).

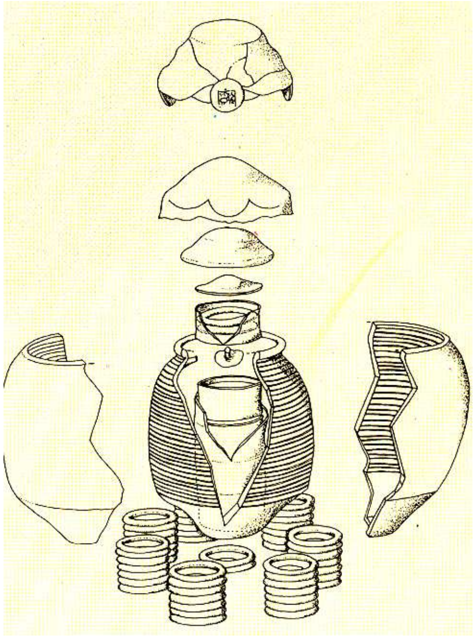

Diagram of canisters and containers for stone-ware bangles (After Halim and Vidale 1984, fig. 63).

Stoneware bangle and inscribed bangle fragment. Mohenjodaro.

Use of Zinc

Va_gbhat.a mentions three alloys: **kam.sya** (bronze: 80 parts copper 20 parts tin: Rasa Ratna Samucchaya (RRS), Ch. 5/205; **ri_tika, ka_katun.di** (brass: copper and zinc; RRS Ch.5/191-192); and **varta loha** (alloy of brass, copper, bronze, iron and lead; RSS, Ch.5/212). [K. Nagesh Rao and PR Rangesh, 1998, A scientific analysis of iatro-metallurgical practices of ancient Indians, in: Vibha Tripathi, ed., *Archaeometallurgy in India*, Delhi, Sharada Publishing House, pp. 141-147] **High-zinc** brass is referred to **a_raku_t.a** in Arthas'a_stra. Ra_ma_yan.a (2.105.4; 3.14.15) also refers to **kam.sya, a_raku_t.**a and **ta_mra** referring to the mineral ores found in rocky uplands. Rasajalanidhi, an alchemical text refers to **varta-loha** as 'an amalgam of bell-metal, copper, brass, iron and lead. It is also called **pan~ca-loha** (amalgam of five metals)…**Tri-loha** is 'twenty-five parts of gold, sixteen parts of silver, and ten parts of copper, melted together, form what is called triloha' (B. Mookerji, repr. 1984, *Rasajalanidhi*, 5 vols., Ahmedabad, III: 147; III: 152).

There is a distinction between bell-metal and brass. **kam.sa** is bell metal; **a_raku_t.a**, **ri_ti** and **pittala** are the terms used to connote brass. In CDIAL 966, **ri_ti** is interpreted as yellow brass, bell-metal; Apte's lexicon expands the meaning to include, 'rust of iron'; while Monier-Williams' lexicon (1872: p. 847) provides the following meanings: 'brass, bell-metal, pale brass, calx of brass, rust of iron, scoria of any metal or oxide formed on the surface of metal by exposure to heat'. Bell-

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metal vessels are fees for the performance of yajn~a (*Gobhila Gr.hyasu_tra*: 3.2.35,45; Oldenberg 1892,II: 74-75).

The presence of zinc in a Lothal artefact (2200-1500 B.C.) (No. 4189) assayed: 70.7 percent copper; 6.04 zinc; 0.9 Fe, 6.04 acid-soluble component (probably carbonate, a product of atmospheric corrosion). The zinc and other components could have come from the Ahar-Zawar area, Rajasthan. The next dated brass artefacts are: from the Gordian tomb in Phrygia of the eigth and seventury B.C. and Etruscan bronze of the fifth century B.C. containing 11 percent zinc.

Some early alloyed objects analysed from the Painted Grey Ware level at Atranjikhera showed alloying with 52.42% copper, 20.72% tin, 9.77% lead and 16.20% zinc. This is related to the tradition of mixed alloys or **bharans** among the traditional craftsmen of Bha_rata. [cf. Dilip K. Chakrabarti and Nayanjot Lahiri, 1996, *Copper and its alloys in ancient India*, Delhi, Munshiram Manoharlal, p. 10].

Thin, well-levigated, wheel-made painted grey ware pottery. Some pottery are painted with black or red geometric designs. Typical are: convex-sided, flat-based dish, flat-based, straight-sided bowls, a lot.a (vase) with a straight-sided body and straight neck. The ceramics of PGW have been found in the Ghaggar, Sarasvati and Ganga basins and often related to the early iron age of Bharat. [Photos courtesy: http://bosei.cc.u-tokai.ac.jp/~indus/english/3_1_07.html]
KTM Hegde and Ericson, J.E., 1985, Ancient Indian Copper Smelting Furnaces, in: *Furnaces and Smelting Technology in Antiquity*, ed. P.T. Craddock, Occasional Paper No. 48, British Museum, London, pp. 59-67: The survey covered six ancient copper ore mining and smelting sites in the Aravalli (Arbuda) hills extending over a thousand kms.: Khetri and Kho Dariba in NE, Kankaria and Piplawas in the Central part and Ambaji in SW.. A large majority of mine-pits measure 7-8 metres in dia. and 3-4 metres deep showing evidence of fire-treating of the host rocks on the mine walls to widen rock joints. The evidene indicated probable mining in the chalcolithic period. Timber supports recovered from a gallery at a depth of 120 metres at Rajpura-Dariba mines in Udaipur District were radio-carbon dated to 3120+_ 160 years before the present (1987). This correlates with the zinc-containing copper artefacts of Atran~jikhera. Finely crushed ore was concentrated by gravity separation at the smelting sites which were invariably close to the banks of hill streams. This helped separate gangue from the ore. Smelting charge was by crushed quartz equal to the weight of the ore, crushed charcoal twice the weight of the ore. Furnace walls showed evidence of residues of small, hand-made, fistfuls of spherical lumps. The smelter furnace was a small, crucible-shaped, clay-walled, slag-tapping deice worked on forced draught from bellows; 'this simple furnace appears to have been continuously used in India over the millennia without little innovation.' It would appear that the facilities in the metropolis of the civilization on the banks of Sarasvati and Sindhu were only purification and fabrication facilities with limited or no smelting operations. Bun-shaped copper ingots from Ganeshwar taken through the riverine routes were perhaps carried by

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itinerant metal-smiths of the copper-hoard culture and fabricated in cities like Mohenjodaro and Harappa to meet the specifications of the consumers of this doab or the Tigris-Euphrates doab.

“The few analyses which have been performed, such as on the objects from Taxila, now in Pakistan suggest brass was in use from the 4th cent. BCE, and at least some of the pieces may have been made by adding metallic zinc to copper as their zinc content is analysed to be 34.34%Zn. Some of the contemporary Indian medical and scientific treatises such as the Charaka refer to a metal ‘Rasa’ to which in addition to forming an alloy with copper, could also beburnt and the ashes used as an eye salve. This can surely only be zinc.” [PT Craddock, IC Freestone, Lynn Willies, HV Paliwal, LK Gurjar and KTM Hegde, 1998, Ancient History of lead, silver and zinc in Rajasthan, in: Vibha Tripathi, ed., *Archaeometallurgy in India*, Delhi, Sharada Publishing House, p. 123].

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Lead, silver and zinc at Zaawar

Large updraft kiln of the Harappan period (ca. 2400 BCE) found during excavations on Mound E Harappa, 1989 (After Fig. 8.8, Kenoyer, 2000)

"…early mines of Zawarmala and Mochia at Zawar…numerous radio-carbon dates obtained. These show beyond reasonable doubt that major mining operations were carried out during the later part of the 1st millennium BCE. The ore extracted from these enormous workings was predominantly sphalerite (ZnS), with small amounts of lead, having low silver content…The importance of Zawar zinc production technology is reflected in the sentiments expressed by Royal Society, London, at 'Conversazione' organized on 20th June 1985, which are as follows: 'Excavation by British Museum, Baroda University, and Hindustan Zinc Limited, at Zawar, Rajasthan, have uncovered blocks of intact furnaces still holding their original charge of 36 retorts per furnace. The technical sophistication and application of scientific principles are unparalleled elsewhere in the late-Mediaeval period, and the element of standardization and mass production foreshadow the Industrial Revolution. This is the earliest example of high temperature distillation is almost certainly ancestral to all such operations today.' " [PT Craddock, IC Freestone, Lynn Willies, HV Paliwal, LK Gurjar and KTM Hegde, 1998, Ancient History of lead, silver and zinc in Rajasthan, in: Vibha Tripathi, ed., *Archaeometallurgy in India*, Delhi, Sharada Publishing House, p. 123-132]

Copper ledged cooking vessel with high neck and flaring rim, identical to many terracotta vessels. A sheet of copper was hammered and the hollow base and rim are raised separately; the two pieces were joined together with cold hammering at the ledge. This vessel contained a hoard of copper weapons and tools. National Museum, Karachi. Vats 1940: 85, 384, pl. CXXIV. 27.28 (After Fig. 8.2 , Kenoyer, 2000)

A series of pottery kilns were discovered in 1989 on the northwestern corner of Mound E at Harappa. These kilns constructed circa 2800 BCE continued to be remain in the locality for hundreds of years. Ceramics were coloured red using red ochre (iron oxide), and black using red-brown iron oxide and black manganese. "Even the most valuable metal containers, such as the silver jars with lids from Mohenjodaro, are made in the same style as tall ceramic vessels with flaring rims."

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(Kenoyer, 2000, p. 156; John Marshall, *Mohenjdaro and the Indus Civilization,* London, Probsthain, 1931, Pl. CXL. 1-3 and 585-586).

A full-scale reconstruction of the ancient Harappan kiln, first built in 1989, is repaired and reused each year for experimental pottery production at the Harappa Archaeological Research Facility. In 1996 a large storage jar was fired along with other types of pottery and figurine replicas. (After Fig. 8.8, Kenoyer, 2000).

Harappa had a number of furnaces. Harappa is loated at the confluence of two *sukhra_va_s* (dry beds of the Ravi river), 15 miles WSW of Montgomery town. Copper objects found: toy model of a two-wheeled copper chariot, copper antimony rod stopper, copper mace-head, copper beads, ornaments. A large hoard of copper and bronze implements was found in a copper jar No. 277, Mound F: one hundred weapons, implements, utensils both finished and unfinished, cast bars, lance-head, bangles, thick sheet of copper with hammer marks (EH, 470-73). In 48 samples examined, the percentage of arsenic (harita_l) ranged from .3 to 7 percent); the percentage of tin ranged from 1 to 14 percent. Rajputana mines contain As (Arsenic) and Ni (Nickel) . Sources of tin were Hazaribagh, Bihar and Mesopotamia. A simple tin solder of its alloy with lead and soldering of silver and gold were used. In Mound F, 16 furnaces have been discovered: (a) part of round pottery jar; (b) cylindrical pits dug in the ground with or without brick lining; (c) pear-shaped pits dug in the ground with or without brick lining. Jar-furnace filed with charcoal fuel is still in use by goldsmiths in the region. Some furnaces were found with ashes and quantities of vitrified slag. In many furnaces, there is a small rectangular pillar or sometimes a wall set at the back and an air passage for the circulation of heat between itself and the back wall.

Copper/bronze plate with vertical sides, hammered and raised. (National Museum, Karachi. Mackay 938: CXVIII.20; After Fig. 8.22, Kenoyer, 2000)

Ledge-shouldered cooking pot with low neck and flaring rim. Red slip on the neck and rim. Wheel-thrown rim with molded base. Nausharo (ca. 2300 BCE). Karachi EBK 5654. (After Fig. 8.9, Kenoyer, 2000).

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Processing beads and creating white lines (using caper trees – **d.an:gra janum**) Slide 199 Different types of beads, Harappa, 2000. [After slide 199 from the Harappa excavations after 1996.]

Wild caper trees The new green shoots of the thorny wild caper trees of Sindh and Punjab can be crushed with alkaline salts to create a paint-like substance that will bleach white lines on carnelian when heated to the proper temperature. [After slide 201 from the Harappa excavations after 1996.]

Processing gold and in composite products

Gold button. A button or sequin made of thin gold foil with a small interior loop for attachment to clothing. This piece was found crumpled into a small wad, possibly in preparation for remelting to make a new ornament. (H2000-4445/2212-01, Mound E, Trench 54). [After slide 211 from the Harappa excavations after 1996.]

Tiny gold droplet. This tiny droplet of gold appears to be a placer nugget, possibly obtained by panning for gold. (H2000-4410/2102-08, Mound E, Trench 54). [After slide 214 from the Harappa excavations after 1996.]

Black Basalt stone. A black basalt pebble found in the excavations in Trench 54 has a few faint traces of gold colored streaks that may indicate it was used as a touchstone. Pure gold has a strong yellow-orange streak, while alloyed gold yields a slightly different hue. [After slide 215 from the Harappa excavations after 1996.]

Gold bead composite with copper. Composite gold bead with copper-alloy core or wire on interior. The corroded copper still covers part of the tubular gold bead.(H2000-4488/9829-0 , Mound AB, Trench 43). [After slide 20 from the Harappa excavations after 1996.]

Manufacture of copper wire

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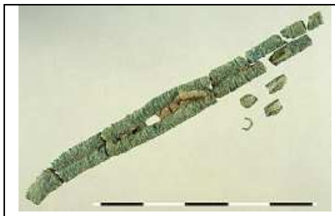

Slide 218 Coiled wire necklace. This unique discovery of a coiled copper-alloy wire necklace (H2000/2242-01) has traces of fibers preserved on the inside. This is among the earliest evidence for finely made wire in the Indus Valley and dates to approximately 2450 BCE (Harappa, Trench 54, early Period 3B). This type of wire is likely to have been made by drawing the wire through a series of graduated perforations. . [After slide 218 from the Harappa excavations after 1996.]

Fire altars in Rakhigarhi (Haryana)

This site is situated in District Hissar, Haryana. Rakhigarhi and is the second largest site of the Sarasvati Civilization in Bharat. This site relates to early (3200 to 2600 BCE) and mature phases (2600 to
800 BCE). A unique feature of this site is the setting up early settlements using cicular and rectangular patterns of sun-dried mud bricks as building materials.

This settelment is laid out with streets, rectangular houses, lapidary and copper-smithy workshops and ceramic manufactures The Mature phase settlements have wall enclosures and an imposing citadel with raised brick platform. On the platform, there were the fire altars and a pit containing bones, charcoal etc. A copper vessel was found adjacent to the platforms; it contained a gold head-band and silver bangles.

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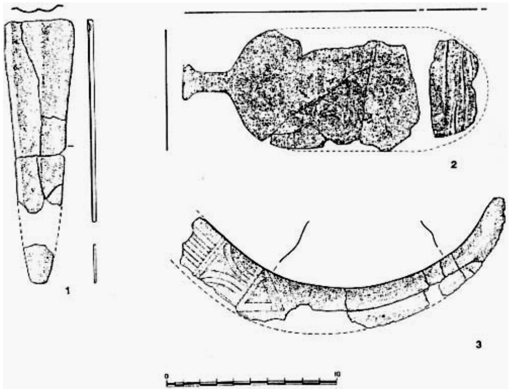
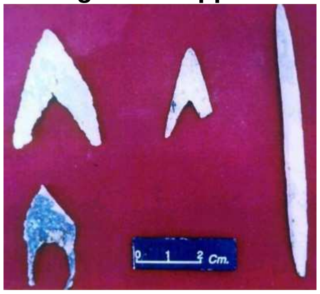
After Fig. 2.4-6. From Sohr Damb. 2.7-8 from Mohenjo daro. - 2.4 Palstaves A 9782.- 2.5 NM 2614.- 2.6 NM 2616.- 2.7 & 2.8 Mohenjo daro Museum, no inv. nos. Silver: Fig. 1.1 Dagger blade NM 2622.- 1.2 Cult object NM 2620.- 1.3 Harvesting knife NM 2619. Figs. 1.1-1.3 Sohr Damb. Those fashioned in silver appear to be exclusively grave goods.The exception is the dagger mentioned above from Area D. Similarity between the "copper weapons and tools" from the Nal cemetery and those of the Harappa Culture: J.-F. Jarrige, in: *Vergessene Städte*, 63.
Source: http://www.rzuser.uni-heidelberg.de/~ju3/forschung/yule3/Yule3.htm
See other links: http://www.rzuser.uni-heidelberg.de/~ju3/forschung.htm]



Rakhigarhi: Copper/bronze  **weapons** (Courtesy ASI)	**Rakhigarhi: Copper bangles** (Courtesy ASI)	**Dholavira: Copper/bronze weapons** (Courtesy ASI)

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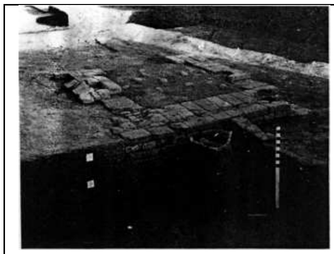
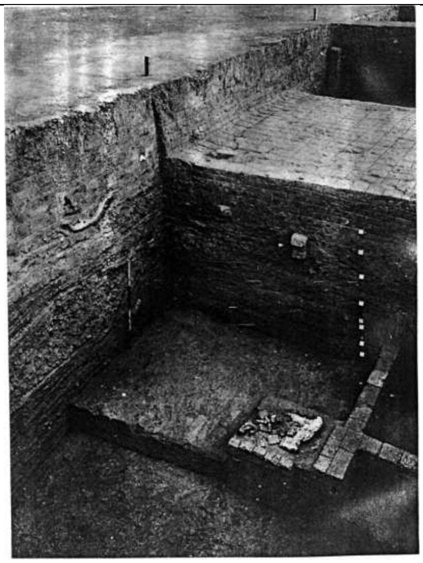
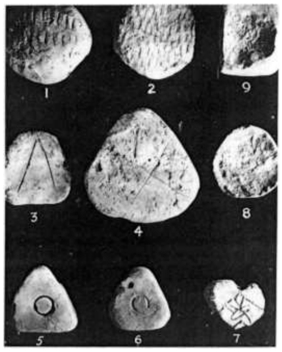


Lothal. Fire altar of burnt bricks exposed in Street 9 [After Pl. CXXX in: SR Rao].

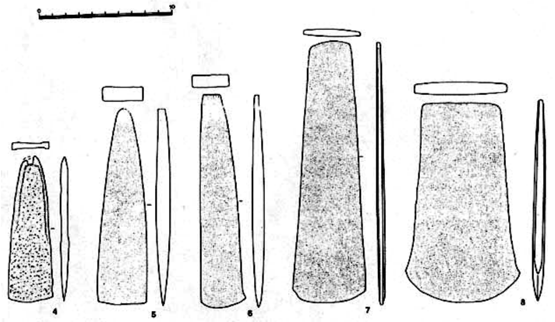
Lothal. Fire altar with bones. [After Pl CXLVIII in SR Rao].





Lothal. Terracotta cakes (Period A) from fire altar [Afte Pl. CL in: SR Rao]. Mughal has demonstrated based on the finds from Cholistan sites that the terracotta cakes were used as packing material for fired objects (to prevent dislocation during intense fire) in what he terms as 'industrial sites', i.e. sites with evidence of working with metals using fire-pits.

Lothal had an exclusive commersmiths' quarter (2300-2000 B.C.)(Sr Rao, *Lothal*, Vols. I and II, Delhi, ASI, 1979 and 1985). Lothal is between the Rann of Cambay (khambat) and Little Rann of Kutch, close to the Nal lake, about 52 miles from Ahmedabad and 4 miles from Bhurki. The ancient mound is between Bhogava and Sabarmati rivers. Bronze (low-tin) was used for pins, mirrors, rods, chisels, flat axes, daggers and arrowheads; bronze (high-tin) was used for bangles and pins. Lead was used to harden tools with sharp edges. Tin became a rarity in Sumer by 2700 B.C. until it could be obtained again by 1500 B.C.Sayce cites that tablets from Kara Huyuk refer to tin which was a rare and precious metal in Babylon ca. 2500-2200 B.C. Of the 71 objects from Lothal examined by Lal, only 8 objects contained tin: the tin content of two bangles were 11.2 to 11.82 percent. A grooved rod had 9.02 percent, a mirror 5.47 percent, a pin 13.80 percent, two chisels 9.02 to 9.62 percent, an engraver 3.96 percent, a spear 2.27 percent. Lothal metal-workers knew the art of forging bronze. The manufactured objects found: axes with long narrow blade or broad blade; spearhead, arrowhead, razor, chisels, dagger head, mirror awls and needles, nails and rods, fish-hooks and saw. Personal ornaments of copper and bronze: bangle, ring, ear-ornament, beads. Figurines: bull, hare, dog, bird, fowl. Jar, mirror, spoon, chair were also fabricated. Copper ingots of plano-convex shape (99.81 percent purity) were also found. The ingots from Susa also have a concave under-surface and short projections. Perhaps some copper was imported and remelted in clay crucibles (Rao, 520-21). A coppersmith's workshop was discovered. One furnace was circular with a rectangular projection to supply fuel. A second furnace (House 154) had a muffle. A kiln yielded ash and fragments of terracotta crucibles and a stone mould used for casting pins and awls. A copper pin, a broken copper



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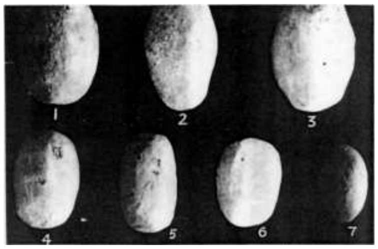
chisel and a hammer stone with a socket for hafting are finds from the vicinity of this workshop. A sample of cementation brass (1500 B.C.) from Dwaraka has also been reported. Electrum was used for making gold pendants (Rao, 664-65). Kolar gold-fields yield electrum. At the smiths' workshops were found clay tablets containing impressions from the Harappan seals. (These are further analyzed in this website).

Lothal. Terracotta lumps from fire-altars (Period B) [After Pl. CLI in SR Rao].



Kalibangan. A 'fire-altar' in one of the rooms of a house in the 'Lower Town' (KLB-2). The room was specially earmarked for putting up the 'fire-altar' which was renewed as the working level rose. [After Pl. 11 in: BB Lal and SP Gupta, eds., *Frontiers of the Indus Civilization*].

Terra-cotta pointed base goblets

Pottery was fired in updraft kilns. To produce large quantities of storage jars, large pit kilns were used.

"Pyrotechnology, the manufacture of objects or materials.Through surveys and from excavations, we knew that during the Indus Integration Era (ca. 2600-1900 BCE), even smoky, hazardous firing areas were found within the walled centers of the Indus cities. My surveys further demonstrated that firing took place throughout the city of Harappa, not primarily in a single quarter. One of the goals of our continuing excavations of these production areas is to understand why these firing areas were and could be located in the city centers. The Indus Valley period floodplain is now buried by meters of silt, with only the mounded sites visible, but we know from work in other areas of the Indus region that firing areas for pottery and perhaps metals were also found in separate locations, far from habitations. Are these city-located potters producing some very special objects? Or is it just a question of long-term occupation of a location, with the city growing up around them?

"Looking more broadly across all types of crafts, there is evidence for some general patterning to the location of production. In line with findings from the German and Italian project at Mohenjo-daro, I found that working areas for Reductive crafts (lithic and shell-working) tended to be found together, while pyrotechnological crafts (pottery, copper) were located primarily in discrete areas, away from other crafts. For example, my surveys at Harappa in 1994 and 1995 and excavations in 2000 showed that Integration Era copper melting occurred only in an area in the center of the south side of Mound E (See map of Harappa opposite); no other craft production took place there. HARP excavations in 1989 in the northwest corner of Mound E uncovered two different types of Integration Era pottery kilns, which may also have been used for figurines, but there was no evidence for any other crafts. In contrast, during my survey of the entire site of Harappa, most of the areas with any evidence for lithic production included debris from a variety of lithic materials and object types as well as shell-manufacturing debris. A small

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area in the center of Mound E, subsequently excavated by HARP, seemed focused on drill manufacture and drilling stages of production, but a variety of stone types and other materials (perhaps wood, ivory, shell) were being drilled." (M. L. Miller, Locating Indus Civilization Pyrotechnological Craft Production: Applying surface survey methods and geomagnetic techniques, *Indo-Koko-Kenkyu, Indian Archaeological Studies 2000 Vol*)

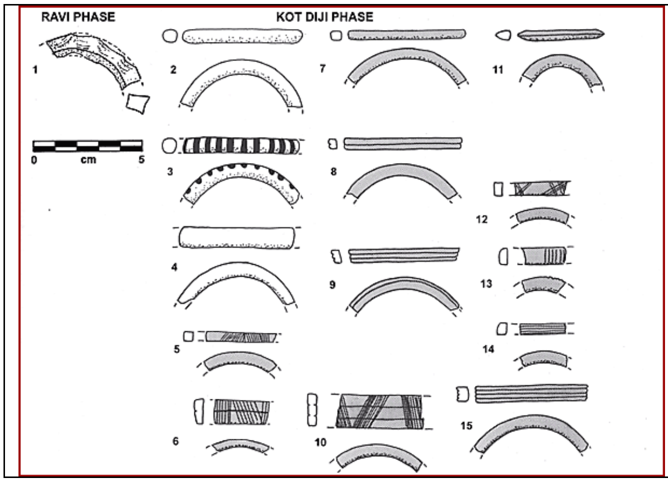
The finds of copper melting crucibles at Mehrgarh (Jarrige, Jarrige et al. 1995) shows the use of technology at a site far from the original source of the raw materials (Kenoyer and Miller 1997). Excavations of copper working areas at Harappa, during the 1990's (Meadow, Kenoyer and Wright 2000) and a large number of copper objects recovered from earlier excavations evidence a long tradition of copper and bronze working at the site (Kenoyer and Miller 1997).

At Harappa, steatite was obtained from distant resource areas and made into various types of beads, some of which were glazed. Steatite seals were carved and fired at the site. Raw materials of colored jasper, agate, carnelian and other varieties of rock were brought and made into beads and pendants.

Since production of faience required high temperatures to attain a glassy, compact substance with a shiny blue-green glaze, special furnaces would have been used.

Furnace for making bangles

Substantial quantities of bangles of all shapes, sizes and decoration have been found in the civilization sites.



Harappa: Ravi and Kot Diji Phase Bangles (After Figure 2, Kenoyer, 2002)

Steatite bangles were made using special type furnace.

Materials were used to make bangles were: clay, shell, metal and faience. In addition, the quality of workmanship shown in the manufacture of the bracelets suggests that they were made for different levels of society.

The marine shell used was *turbinella pyrum*. Techniques used were: incising with stone tools, grinding, and polishing. Red-fired and grey-fired terracotta

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bangle types include: flat painted bangles, rounded bangles, and a bangle with incised decorations.

Xancus Pyrum

Silvio Durante's study (1979) of marine shells which are exclusively found along the coastline of India notes their appearance in distant sites such as Tepe Yahya and Shahr-i Sokhta in Iran, as well as in the Sarasvati-Sindhu Valleys. It is possible that culture, technology, religion, followed such trades.

Durante notes that the marine shell *Xancus pyrum* was traded whole and intact, then worked or reworked at destination sites, before perhaps moving on to other locations.

'*Xancus pyrum* has a very limited geographic distribution and thus has almost the same significance in the field of shells as that of lapis lazuli in the context of mineral resources as regards the determination of the possible routes along which a locally unavailable raw material is transported from a well-defined place of origin to the place where it is processed and, as also in the case of Xancus pyrum, consumed' (Durante 1979:340).

Durante (Durante 1979) offers four possible trade routes: sea route direct to the Iranian coastal area; sea route to Sutkagen-dor and Sotka-koh on the Makran coast, then overland westwards; overland through the Indus plain and then through the Makran interior to Sistan; overland through the Indus Valley and then through the Gomal Valley to Sistan.

Natural resources map of ancient Bharat
Source: http://www.ancientindia.co.uk/indus/story/sto_set.html

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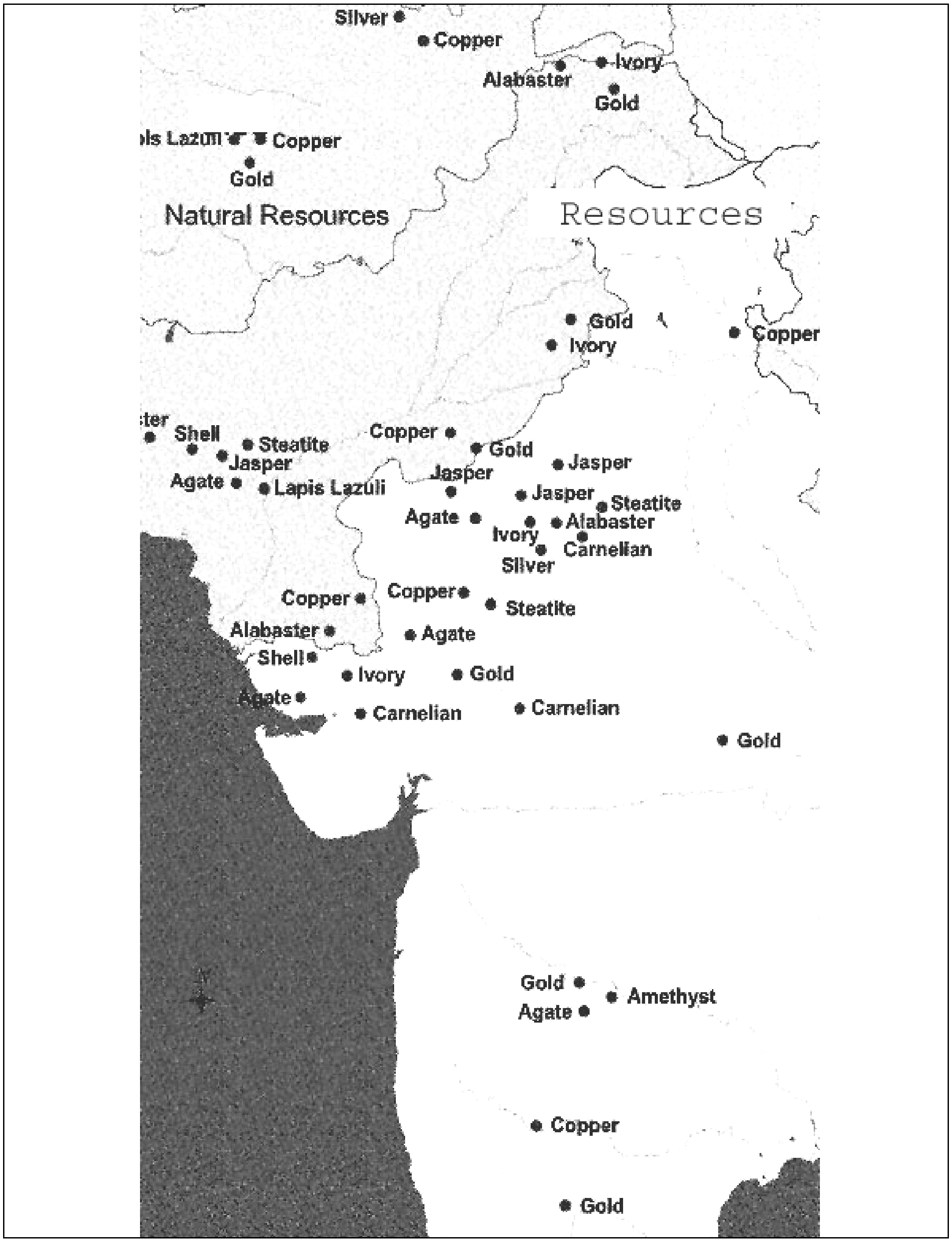

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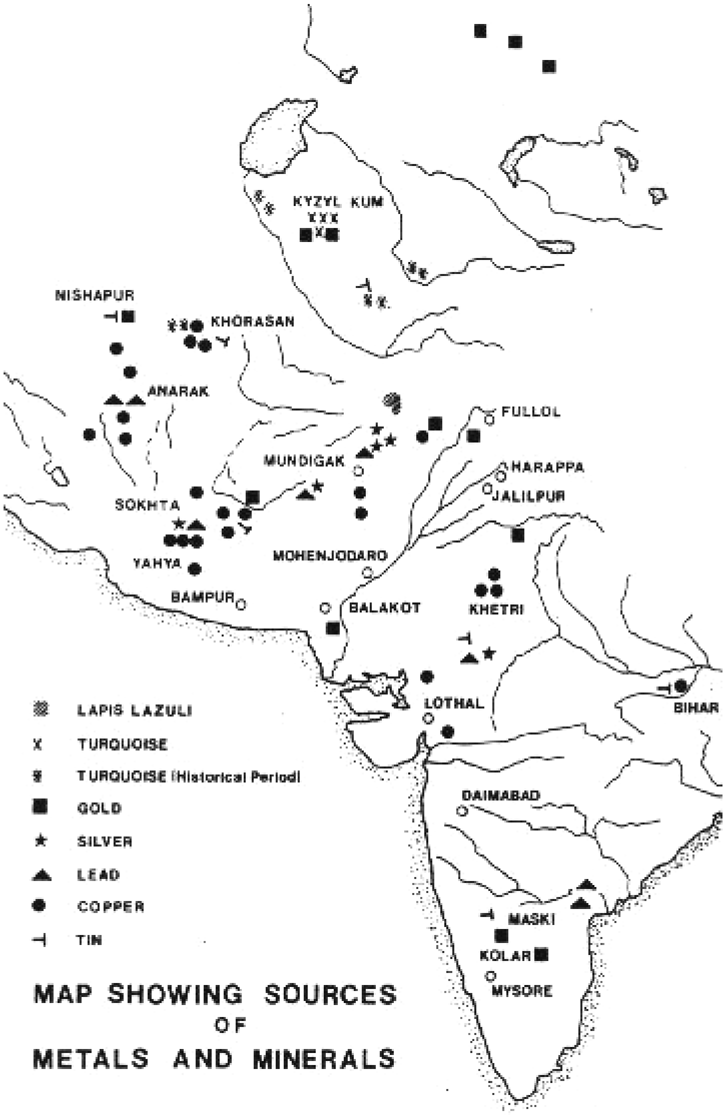

Sources of minerals and metals

The sources for the minerals and metals and semi-precious stones were: Baluchistan, Afghanistan, Iran, Central Asia, the lands bordering the Persian Gulf as well as interior, peninsular India (Map based on Shashi Asthana, Harappan Trade in Metals and Minerals: A Regional Approach, in: *Frontiers of Indus Civilization*.)

Sources of gold: Coimbatore (Hadabanatta, Kavudahalli and near Porsegaundanpalayam), Wynaad and Kolar (Marshall 1931: 674). "South of the Caucasus, in Armenia, the famous metal workers, the Chalybes, are credited with rich mines. This probably means the deposits near the Taldjen River, close to Artwin... The Muruntau mountains in the Kyzyl Kum desert has the largest deposit of gold (Forbes 1971: 166; Kalesnik and Pavlenko 1976: 202)... The discovery of the famous Fullol Hoard

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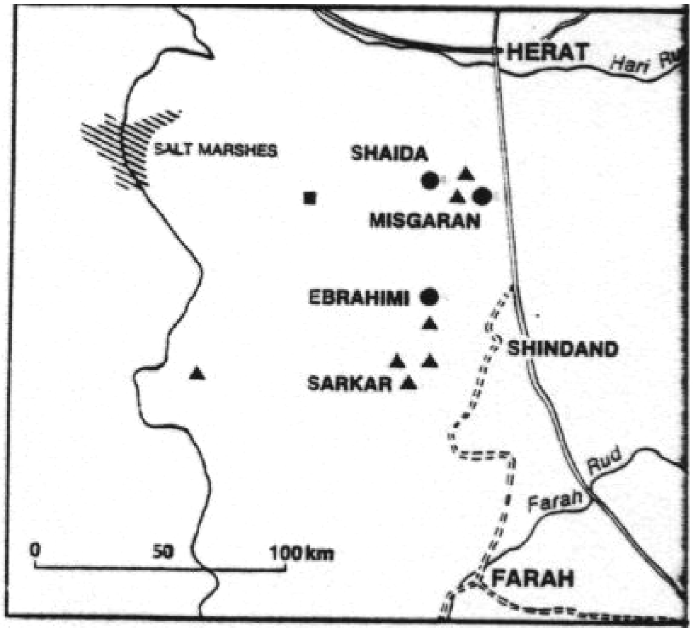
in the Hindu Kush of northern Afghanistan (Tosi and Waradak 1972: 9-17) contained a number of gold objects with Mesopotamian and South Turkmenian motifs. This proves that the region (the Oxus basin--northern Hindu Kush) was as important to the Middle East for gold as it was for lapis lazuli. Incidentally, the Harappan trading posts at Shortugai are also in the same region (Francfort and Potter 1978:29).

"**Catalogues**. The most extensive published collections of metal objects are those from the early excavations at the Harappan Phase sites of Mohenjo-daro (Mackay 1931, 1938; Marshall 1931), Harappa (Vats 1940), and Chanhu-daro (Mackay 1943), all in the Indus Valley. The metals from excavations at Rangpur (Rao 1963) and Lothal (Rao 1979, 1985) provide information on the metals of Harappan Phase Gujarat. Information on metal use in the greater Indus region prior to the Harappan Phase comes primarily from the site of Mehrgarh (Jarrige and Lechevallier 1979). For the Harappan Phase, the best references are the catalogues of metal objects compiled by Yule (Yule 1985), providing descriptions and illustrations of the copper objects from Mohenjo-daro, Harappa, Lothal and several other sites, including many objects previously unpublished….

"The role of metal during the Harappan Phase…It is clear that metal objects were not simply utilitarian or symbolic, but that they played a variety of roles in the economy, technology, and socio-ritual/ornamental aspects of the Harappan Phase." (Kenoyer and Miller, 1999, pp. 111-113, 133).[2]



Map of tin and copper occurrences in southwestern Afghanistan: . Prehistoric copper mines; **^** Tin occurrences; **O** -Copper occurrences; = major roads.

The search for minerals took the people of Sarasvati Civilization far and wide not only within Bharat but out of Bharat into Mesopotamia and Anatolia.

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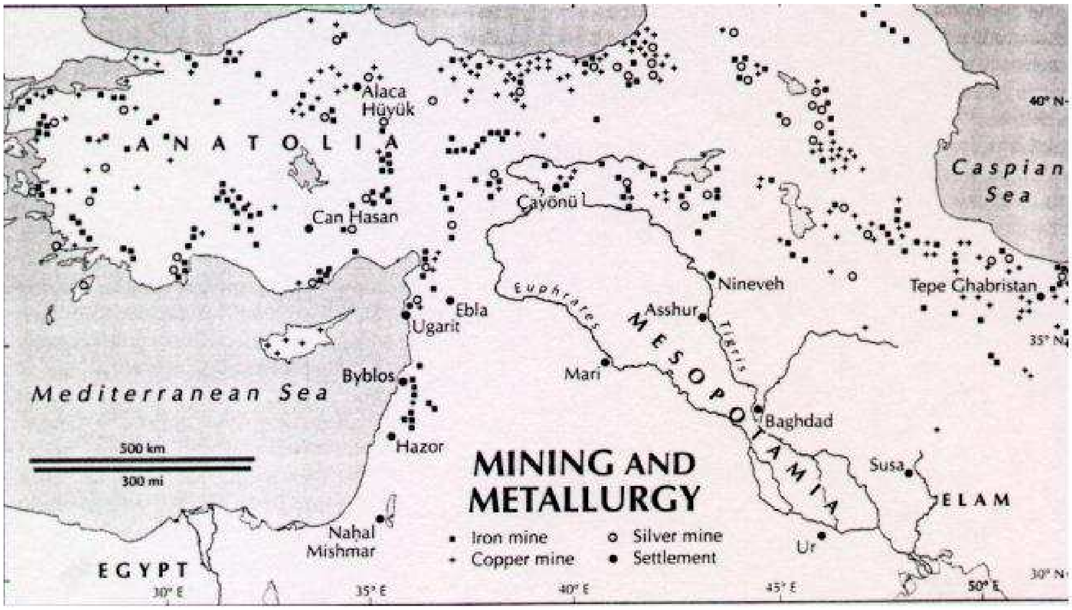

Map depicting iron, silver and copper mines and ancient settlements of Mesopotamia and Anatolia. The trading route through Mari on the Euphrates to Ugarit (Mediterranean Sea) and on to Minoan Crete. This may explain the presence of Harappan script inscription on tin ingots found at Haifa, Israel! [Map is after Markus Wafler, 'Zu Status und Lage von Taba_l', *Orientalia*]

Before the discovery of iron, i.e. in the bronze age, the settlements tend to cluster on river banks with easy access to the mines of copper and silver.

Map of Anatolia and Mesopotamia showing Copper and Tin deposits and ancient sites

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The malleability of unalloyed copper, which renders it too soft for weapons, helps form vessels of every variety of form. Copper domestic vessels were regularly made in Sumer during the 4th millennium BC, in India during the third millennium BCE and in Egypt a little later.

This provides a perspective for the dawn and development of the bronze age in the Sarasvati-Sindhu civilization, ca. 2500 BCE with the import of tin from sites close to the Euphrates river (Sumer) to alloy with the copper available from the Khetri mines in the central Sarasvati river basin.

Lothal. Bun-shaped ingot (Copper). [After Pl. LXIII in SR Rao].

Copper. Sources. "Muhly (1973: 220 ff.; 1976: 104 ff.) has thoroughly reviewed the ancient textual sources for the use of copper and its trade in Mesopotamia, with extensive commentary on their relation to known deposits in the area. Archaic texts frok Uruk (III) indicate that already by the later fourth millennium BCE Dilmun was engaged in the metals trade (Englund 1983). In the third millennium Sumerian texts list copper among the raw materials reaching Uruk from Aratta (Pettinato 1972: 82-3, 128) and all three of the regions Magan, Meluhha and Dilmun are associated with copper, but the latter only as an emporium (Limet 1960: 85ff.; Waetzoldt 1981). Gudea refers obliquely to receiving copper from Dilmun: 'He (Gudea) conferred with the divine Ninzaga (Enzak of Dilmun), who transported copper like grain deliveries to the temple builder Gudea...' (Cylinder A: XV. 11-18: Englund 1983: 88, n. 6). Magan was certainly a land producing the metal, since it is occasionally referred to as the 'mountain of copper'. It may also have been the source of finished bronze objects (Limet 1972: 14-17).

In the early second millennium BCE Mesopotamia may have lost direct contact with Magan, and with Meluhha, also earlier mentioned in relation to copper. Copper now came through Dilmun and its traders... Gudea refers to mining copper in the mountain of Kimas' (Falkenstein 1966: i.50 ff.; Statue B.VI: 21-3). This region is assumed to have been somewhere between the Jebel Hamrin and the Lesser Zab (Edzard and Farber 1974: 100-1); an old identification with Ergani Maden in Anatolia is no longer regarded as tenable. If this location is correct, it may have been just an entrepot for copper from mines

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deep in Iran, or it might be a direct reference to the copper-mines visited by Layard in the Tiyari mountains, north of Amadiyeh (Layard 1849: i.223)... Anatolia was not an exporter of copper in the third and early second millennium BCE... As already noticed, after the Ur III period direct trade from Mesopotamia down the Gulf to Magan appears to stop and Dilmun becomes the primary entrepot for all Gulf Trade, including metals, in the earlier second millennium BCE. Copper came this way until at least the eighteenth century BC, when there is a break in the records almost exactly at the same time as the earliest surviving textual indications of copper from Alashiya (Cyprus) reaching Mari and Babylonia (CAD. alas'u; Schaeffer 1971: 547 ff.; Millard 1973). The Mari texts also refer to a type of copper qualified by the term te-ma-yu, for which Dossin (1970a: 39 n.1) suggested an association with Teima in Saudi Arabia, serving as an entrepot for copper from the Feinan/Wadi Arabah mines (cf. Hauptmann et al 1989). Muhly (1976: 109) was sceptical; but it is not an impossible routing.

Copper came by way of Dilmun until at least the eighteenth century BC, when there is a break in the records almost exactly at the same time as the earliest surviving textual indications of copper from Alashiya (Cyprus) reaching Mari and Babylonia (CAD, s.v. alas'u; Schaeffer 1971: 547 ff.; Millard 1973). The Mari texts also refer to a type of copper qualified by the term te-ma-yu, for which Dossin (1970: 39 n.1) suggested an association with Teima in Saudi Arabia, serving as an entrepot for copper from the Feinan/Wadi Arabah mines (cf. Hauptmann et al. 1989)... It has been argued that it was the eclipse of the Indus Valley civilization in the second quarter of the second millennium BCE that brought to an end the flourishing Indus-mesopotamian trade up the Gulf; but this has yet to be satisfactorily confirmed. Stray indicators suggest continuing, if intermittent, activity. In the middle of the fourteenth century BCE a Babylonian official was stationed on Dilmun, whence he reported back on local threats to the date crop. Then Tukulti-Ninurta I of Assyria (c. 1243-1207 BC), after his sack of Babylon, assumed the title 'King of Dilmun and Meluhha', emphasizing contemporary Babylonian interest in these regions, even if the full implications of the ancient names no longer applied (Brinkman 1972: 275-6; 1976: 314). Danish excavators revealed considerable evidence for the occupation of Bahreain and Failaka in the Kassite period (Bibby 1972: 358 ff.). Otherwise documents contain no explicit references in the later second millennium to the sources of copper (cf. Potts, D. 1990: i. 232 ff.)... Copper occurred extensively in Iran, Afghanistan (Berthoud et al. 1977) and the Indian Subcontinent (Muhly 1973: 234 ff.; Ratnagar 1981: 96-7)...Almost half of the objects so far analysed from Cemetery A (Early Dynastic IIIB) at Kish have arsenic in excess of 2 per cent, as do about 33 per cent of those from the Royal Cemetery at Ur; in the north an arsenical copper tradition is the most prevalent throughout the third millennium BCE... About a third of the total, have tin from 0.012 to 15.9 per cent... at both Gawra and Ur, arsenical copper was the metal in greatest use... siparru means copper when referring to unworked metal; bronze when the object is finished work; eru_ means copper in all contexts; sometimes 'not iron'." (Moorey, 1994, opcit, p. 245)

"... circular bun-shaped ingots found on third- to second-millennium sites in Oman (Hauptmann et al. 1988: 41, fig. 4:6), which indicate that this was the shape in which at least some Omani copper was traded in the Near East at this time. It may, however, have been the standard for many other source zones. A group of five circular bun-shaped ingots of copper were included in the mid-third-millennium BCE 'Vase a la Cachette' excavated at Susa. They have been associated with ingots of this shape found in the Gulf and in Indus Valley settlements (Tallon 1987: nos. 687-92, pls. 262-4). Two bun-shaped ingots were found in a contemporary context at Tell Chuera in Syria (Moortgat and Moortgat-Correns 1978: 66ff., fig. 29a-b).(Moorey, 1994, opcit, p. 244).

As in Egypt, so in India, the smiths who worked in the precious metals of gold and silver also worked in copper and bronze. [Copper pitchers and basins for hand washing at meals were placed in the tombs. An unusual example in the Metropolitan Museum of Art is plated with antimony to imitate silver, which was very rare in the Old Kingdom (c. 2686-c. 2160 BC). The basins and the bodies of the ewers were hammered from single sheets of copper. The spouts of the ewers were cast

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in molds and attached to the bodies by means of copper rivets or were simply inserted in place and crimped to the bodies by cold hammering. Source: 1994-1998 *Encyclopaedia Britannica.*]

Rigvedic and Sarasvati Civilization workers were also fire-/metal-workers like the armourers who produced weapons using copper and tin/zinc alloys yielding bronze and brass.

Metals. Gold is known at Mokar, Afghanistan. (T.A. Wertime, Science 182, 1973, p. 884). "X-ray micro-analysis has shown that inclusions in the bead are composed of an alloy of platinum-iridium-osmium and gold. These three metals form rare alloys, found mostly in placer deposits...supplies from this area could have joined caravans carrying lapis-lazuli using Helmand valley route via Shahr-i-Sokhta to the Persian gulf and then have arrived by the ships carrying the lapis, carnelian, tin and gold from Meluhha to Sumer." (K.R. Maxwell-Hyslop, Sources of Sumerian Gold, Iraq, XXXIX, 1977, p.p.85-86).

"...ancient empires... began to concentrate upon importing the crude metals from these distant smelters. The rulers of the city-states would then release the imported raw material to their own metal-workers for finishing... For the efficient extraction of metals from their ores some form of furnace is needed and, for certain purposes, the fire must be forced by draught. In the simplest operations of smelting, the pieces of ore are mixed in layers with the fuel, and the metal is afterwards collected in a lump from the hearth... Metal-workers were among the earliest specialists in craftsmanship. Neolithic farmers or their women had woven and spun, made their own shoes and pots, and dug their own flint, but the advent of the smith ushered in a new era, in which the urban civilizations of the great river valleys rapidly developed. Thence itinerant smiths ventured into the barbarian fringe to seek ores, and thus spread knowledge of the working of these coloured stones. The awe in which smiths were held is reflected in innumerable legends...

"Strabo and others report that, in the Caucasus, alluvial deposits were worked by washing over a layer of fleeces. The gold particles would adhere to the grease in the wool--hence the basis of the legend of the Golden Fleece... In cupellation, lead is added to the crude gold, and the metals fused together in a porous clay crucible or cupel. The lead and other base metals are oxidized by a current of air. The resulting molten litharge, containing all the base-metal oxides, is partly blown off by a blast of air, and partly absorbed by the walls of the cupel, leaving a button of refined gold or, if silver was originally present in the ore, of gold alloyed with silver. Agatharchides (second century BC) is quoted by Diodorus (III, 14, 3-4) as describing the removal of silver as well as the base metals by a modification of the cupellation process: 'The workers place the crude gold in a clay vessel, and add a mass of lead, a little salt and tin, and barley husks. Then it is closed with a tight-fitting lid, sealed with lute, and heated for five days and nights in a furnace. After a suitable interval for cooling, nothing is found of the other materials in the vessel, but only pure gold' (Abbreviated).

"Evidently, at any rate in the first stage of this operation, while the access of air is prevented, the carbonaceous barley would act as a reducing agent. In this period, the metals would be fused and the silver converted to silver chloride by the salt. Later, we must suppose that air is admitted, perhaps through cracks; the barley husks would then burn away, and the base metals would be oxidized and absorbed by the crucible. Perhaps the lid is finally removed, and the heating continued for a short period longer to bring about the cupellation... Silver and lead were closely associated because both were obtained from the same mineral, galena. This is predominantly lead sulphide, but usually has a small proportion of silver. Its occurrence is widespread, and it is often associated with copper ores. Its brilliant metallic appearance may have attracted the attention of the early copper-smelters. The few galena depsits of Egypt were worked for eye-paint only, and in any case the lead produced later from these ores contained little silver...

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"It is doubtful whether the rich deposits of India, Afghanistan, and Persia played a part in the ancient Near East, where much more importance must be attached to the many galena deposits rich in silver in the Armenian mountains, and in the central part of western Asia Minor. Classical tradition and archaeological evidence both point to north-eastern Asia Minor as the birthplace of silver. The 'land of the Chalybes', so important an early centre of metallurgy, was the mining district of the Hittites, whose very capital bears a name written with the ideogram for silver. Asia Minor held an almost complete monopoly of silver production, and Sumerian and Assyrian cities sent their merchants to the Hittites to acquire the silver and lead produced in that country.

"Earlier potentates like Sargon the Great and Gudea, ruler of Lagash, dispatched expeditions to acquire these metals in the 'silver mountains' of Armenia. The Cappadocian tablets (ca. 2000 BC), however, show that there were at that time permanent settlement of Mesopotamian merchants in the land of the Hittites, buying crude and refined silver, pure lead, and pigs of lead, all in sealed in containers to prevent pilfering during transport. From the accounts, it is evident that several qualities were produced. The silver was usually sold in bars, and about four times as much silver as lead was sent to the home country...

"By the first millennium BC, silver and lead were common metals all over the Near East, except in Egypt, where the phase of metallurgy was delayed for another 400 years. The amounts of these metals taken in tribute and booty by the Assyrian king Tukulti Ninurta II (889-884 BC) afford evidence of extensive production. Between 400 and 1000 kg of lead and 100 kg of silver were captured during his expedition into the northern mountains, which shows that the region between Lake Van and Lake URmia was already producing them in large quantities. In Egypt, on the other hand, though importation had begun, the comparative value of silver to gold was still as high as 1:2 at the time of the Persian occupation. The Persian victory of Egypt took advantage of this strange situation, and enriched himself by introducing a silver coinage into the country.

"Supplies of silver became plentiful in Egypt only in Hellenistic times, when the price of silver dropped to only one-thirteenth of that of gold. The production of silver and lead was responsible for the introduction into general metallurgy of the methods of working sulphide ores and of cupellation. The working of galena entails partial desulphurization by roasting, followed by reduction of the product, litharge (lead oxide). A simple hearth-furnace or a sloping trench sufficed. The fule and ore were thoroughly mixed together, or built up in alternate layers. Natural or artificial blast supplied the necessary air. A proportion of the sulphur escaped as sulphur dioxide, but some remained as unchanged galena and lead sulphate. When the correct stage of desulphurization was reached, the temperature was raised, and the litharge, lead sulphate, and galena interacted to form lead, which collected at the bottom of the furnace, while the remaining sulphur escaped as sulphur dioxide. The charcoal added as fuel would prevent re-oxidation. The product was a lead-silver alloy harder than pure lead; it contained many impurities, such as antimony, copper, tin and arsenic. This ancient process combined the two modern stages of roasting and reduction. Though the technique was comparatively simple, the chemical reactions were correspondingly complex, and the ancien metallurgist had not yet sufficient knowledge to control them fully. The inevitable result was a small yield... silver was obtained from silver-bearing lead by cupellation. The litharge slag could be used as such, or reduced with charcoal to lead. Finds of pure silver at Ur, at Troy (six bars of pure silver), and at other places, as well as historical data, lead us to conclude that cupellation was invented in north-eastern Asia Minor in the first half of the third millennium BCE.

"The fining-pot and the drossing of base metals are frequently mentioned in the Bible (Prov. xvii.3; Jer. vi.29-30; Ps.xii.6). By about 60 BC, cupellation was well known. Liquation, a method of extracting gold and silver from other sources such as certain crude coppers, was perhaps also known at this time in the Near East. It involved alloying the crude metal with lead and slowly melting it. The lead flowed away

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with the precious metals in solution, leaving a poroud mixture of the remaining base metals. Liquation was followed by cupellation... The silver:gold value-ratio gives an interesting indication of the supply of silver. It was comparatively high in the earlier periods in Mesopotamia (1:8), and rose still higher to 1:6, in the reign of Hammurabi, perhaps because of disorder in Asia Minor and Armenia. It fell soon afterwards to 1:10, and remained at that level for a very long period. In Neo-Babylonian and Persian times the ratio varied between 1:12 and 1:13." (Charles Singer, et al (eds.), A History of Technology, Oxford Clarendon Press, 1954, pp. 576-585).

"The metal found at the necropolis of Susa, with or without a cloth covering, proved to contain 92.12 percent pure copper, without iron, sulfur, lead, zinc or manganese, but with traces of nickel. Objects from Tello have yielded similar amounts; at Tell-el-Obeid, copper in most cases exceeds 95 percent of the total. The same results were obtained by R.C. Thompson in the cases of objects from Eridu. Thus pure copper, and not merely antimonial bronze, as has been claimed, was in fact in existence in the early centuries of the third millennium. Since copper did not exist in Sumer, its presence there indicates trade relations with the Caucasus and Anatolia.

From Tello: Lancehead, copper blade 31 1/2 in. long, belonging to a lance;incised with the glyph of a lion; the title 'King of Kish' is legible with the sign 'Sharru'; tang is pierced with 4 holes and a flat surface of the blade is engraved with the figure of a lion; found six inches above the stratum in which the remains of Ur-Nina (founder of the first dynasty of Lagash) were buried (Cat., p. 367; Dec. en Chald., Pl. 5 ter, No.1. Musee du Louvre).

Bas relief, Tello: long haired person carrying on his shoulder a hooked sceptre; a fillet is held in his left hand and is presenting it to the warrior standing in front of him with a lance in hand. (Musee du Louvre, Cat., pp. 87,89 No. 5).

"Bronze is constantly in evidence after the time of Gudea; in most cases it is tin-bronze or antimonial bronze. Elam, which was particularly noted for metalworking has left remarkable bronze monuments dating from the second half of the second millennium BC, the most striking being the statue of Queen Napir-Asu. This statue was cast in two halves, and was then filled with molten bronze forced in with a metal block to cause it to fill the interior completely (this part of the operation failed). The destroyers of the monument were able to remove the head and one arm; the statue, even with the head and one arm missing, still weighs more than 3,960 pounds, and is five feet tall. It must have been extremely difficult to maintain successfully the metal in each crucible at a constant temperature (they were poured out one after the other).

"Gold from the north and from Egypt, as well as silver and the other metals, has been discovered in large quantities in the royal tombs of Ur. The Sumerians already knew how to refine it and remove its impurities. Certain objects from the royal tombs at Ur--the headdress of Meskalamdug, for example--are very solid, but very often gold was used simply for 'gilding'. At Khorsabad, for example, the bitumen-coated trunks of palm trees were covered with a bronze facing that simulated the scales of the palm tree; then gold leaf, annealed to make it flexible, was burnished and nailed to this bronze facing with small nails.

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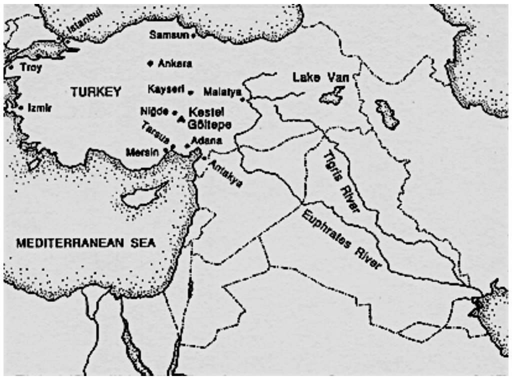
"Silver, more common than gold, was used in the same manner; before coins came into existence it was a unit of exchange used for the payment of purchases, as by barter. Refining of gold was necessary in view of the impurities this metal contained; King Burraburias of Babylon complained to Amenhotel IV (circa 1370-1352 BC) that the gold received from him contained three-quarters of its weight in impurities. The fine gold used in the objects found in the tombs at Ur was approximately 75 percent pure gold. The refining method used was a variant of our cupellation, as is indicated by the purification of five minas of gold by means of successive stages in the furnace; on the first round the gold was reduced to four minas, five shekels, on the second to three and two-thirds minas. The Mesopotamians knew how to alloy and harden gold, which permitted it to be used for weapons." (Maurice Daumas, opcit, p. 133).

Some seals mark the stages along this trade route such as the one from **Tell Asmar (Eshnunna), Iraq. IM 14674; glazed steatite seal**; Frankfort, 1955, No. 642; Collon, 1987, Fig. 610.

Sources of tin: the great enigma of Early Bronze Age archaeology

By 3000 BCE the use of copper was well known in the Middle East, had extended westward into



the Mediterranean area, and was beginning to infiltrate the Neolithic cultures of Europe.

Trapu is tin in the *Atharva Veda* (11, 8.7-8: **s'ya_mamayah asya ma_m.sa_ni lohitamasya lohitam; trapu bhasma haritam varn.ah pus.karamasya gandhah**) and van:ga is also tin with the possible association of chalcolithic cultures in Bengal (2nd millennium B.C.) with possible links with the culture of Thailand of the same period (Solheim, W.C., *Sciene*, Vol. 157, p. 896). Hegde suggests the possibility that water-concentrated placer deposits referred to as 'stream tin' in the proximity of Aravalli and Chota Nagpur Hills might have also been the sources of tin.

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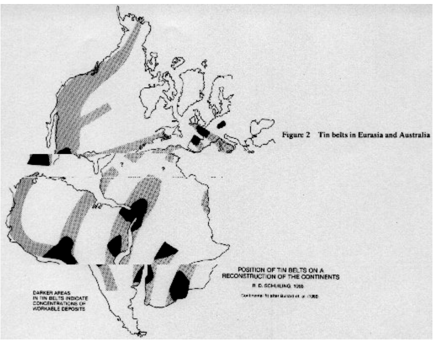
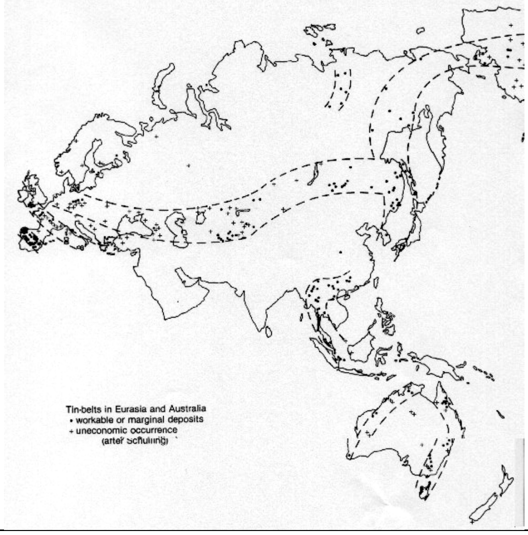
Tin belts in Eurasia and Australia (After Fig.2, Schuiling, R.D., 967, Tin belts on the continents around the Atlantic Ocean, *Economic Geology*, 62: p. 548)





Tin belts on a reconstruction of continents some 150 to 100 million years ago; a European-Asian belt starts with Erzegebirge tin province and extends eastward through Southern Russia, to Uzbekistan, then veers slightly northward to Mongolia, and finally ends up in Northeast China. Another belt descends from Northeast Russia and passes through Korea and Japan, Southern China, Southeast Asia and Malaysia. (After Fig.3. Prentiss S. de Jesus, Considerations on the Occurrence and Exploitation of Tin Sources in the Ancient Near East in:Alan D. Franklin, Jacqueline S. Olin and Theodore A. Wertime, eds., 1977, *The Search for Ancient Tin*, Washington D.C., US Government Printing Office, pp. 39-42).

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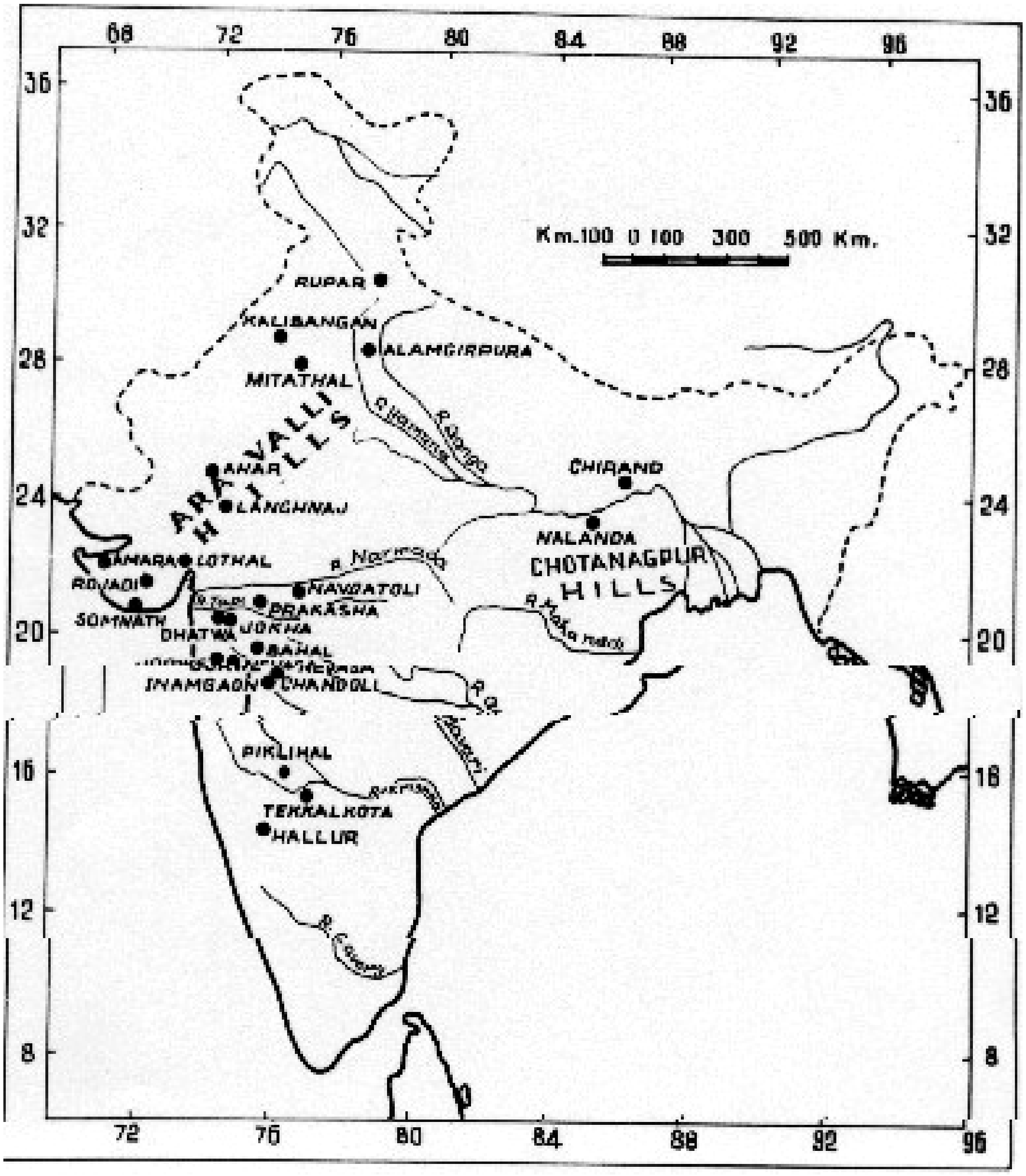
Sources of Tin for the Bronze Age in the areas close to Aravalli and Chota Nagpur Hills India



Sites of ancient Indian excavated and copper and bronze objects (Fig. 1 in Hegde, opcit.)

"I have analyzed 38 representative metal objects, selected from among 76 objects, excavated from six post-Harappan sites: Mitathal, Ahar, Somnath, Navdatoli, Jokha, and Chandoli; distributed in

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Central and western India and in the Deccan plateau. These objects were recovered from the strata that are dated to ca. 1500-1000 BCE. The objects included axes, chisels, knives, daggers, bracelets, and bangles. Among the 38 objects analyzed, 7 were found to be made of bronze. Their tin content varied from 3.12 to 12.82 percent. The other objects were made of copper...At Nalanda in Bihar, excavations have brought to light over five hundred metal images. These images are dated AD 800 to 1200. From among them, BB Lal selected 18 images for chemical analysis. The study revealed that 9 of the images were made of bronze. In their composition, the percentage of tin varied from 7.88 to 23.68 (Lal, 1956, p. 56)...from the foregoing, it is possible to observe that tin was used in India to produce bronze tools and ornaments during the protohistoric Bronze Age and again during historic times to produce statuary...

Kumbharia (2 kms. east of Ambaji) is a pilgrimage centre for the Jains, which has a temple with metal images of Ti_rtha_n:kara, dated ca. 11th cent. AD. Kumbharia is located near a mountain known as Arasur which has many mines of non-ferrous metals. (cf. ancient texts: *Pura_tan Prabhanda San:graha,* 1030 AD and *Upades'a Saptat*i, 1477 AD; the texts also refer to Amba_ji in Banaskantha district of North Gujarat as sources of copper and other metals). (Swarna Kamal Bhowmik and Mudrika Jani, Literary references on metals, metallic objects of art and metal technology, in: Vibha Tripathi (ed.), 1998, *Archaeometallurgy* in India, Delhi, Sharada Publishing House).

Tin from Meluhha

Tin might have been obtained from the mines in southern central Asia and Iran through Shortughai. Within Bha_rata, the nearest major source of tin is the region of Bastar (Orissa, southern Madhya Pradesh).

Lead is plentiful in Mohenjodaro (Marshall 1931: 524)... Rajasthan (Rao 1973: 116), Bihar and Orissa (Marshall 1931: 675) contain several silver-bearing lead deposits; but these are small... the Ajmer and Jawar mines in Rajasthan are likely sources for these metals... Gold mines at Kolar and Anantapur also yield silver with gold, but not in quantity enough for commercial purposes... Lead mines, which could have been a source for silver as well, are situated in Faranjal in the Ghorband Valleyof Afghanistan and are common in southern Afghanistan, especially at Hazara Jat. Well-known silver mines are also known to have existed near the head of the Panjsher Valley in the southeastern Hindu Kush and in the vicinity of Herat... Lead was added to copper to increase the feasibility of molding and has been extensively reported in Harappan artefacts (Agrawal 1971: 156)... Lead might have been used mainly as a smelting flux. This is evident because of the discovery of copper ore together with a small piece of lead in a bricklined pit in a house at Mohenjodaro (Mackay 1938: 41)...

Rajasthan copper mines are at Khetri, Singhana, Kho-Dariba (Alwar), Delwara Kirovli (Udaipur) and Debari (Udaipur) (Seth 1956)... spectroscopic analysis of the Harappan artefacts and various ores shows that there is a close correspondence with the Khetri mines (Agrawal 1971: 175)... there are copper celts, Indus arrowheads and pottery of the third millennium B.C. (Agrawala 1978, 1979) from Ganeshwar (Sikar District)... Khetri is only 60 kilometres from Ganeshwar... There are copper deposits in Zhob district (Mughal 1970: 194), Robat (Hunting Survey Corporation 1961) and Shah Bellaul (Forbes 1972) area of Baluchistan... Huan Tsang mentions copper mines in Afghanistan and ancient workings have been located near the Safed-Kuh between Kabul and Kurram (Forbes 1972: 13). Shah Maqsud also contains rich veins of copper ore and it is said that Nadir Shah exploited them (Forbes 1972: 13). Rich ores are also said to occur at Nesh, 100 kilometers from Kandahar.

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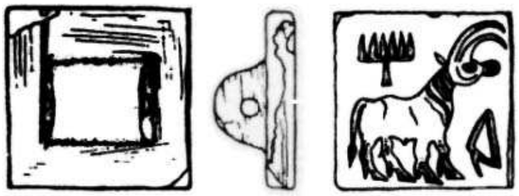
Other localities are Tezin, east of Kabul, Musai in the Shadkani Pass and the Silwatu Pass (Forbes 1972:13). Iran is rich in copper, and metallurgy has a long tradition going back to the fifth millennium B.C. at Tal-i Iblis in Kirman (Caldwell 1967). The best mines are in Kirman as well as Kal-seb Zarre, Sabzwar and Cahr Daud near Meshad, Kaleh near Astrabad and in Elburz mountain districts of Kashan Kohund and Isfahan and Anarak (Wertime 1968)... Kyzyl Kum desert has a copper industry at Temba Bulach but this is of uncertain antiquity (Kalesnik and Pavlenko 1976). The eastern Iranian border also has a long belt of copper deposits...

The ore cassiterite yielded tin. Antimony was another alloy with copper to make bronze; antimony was derived from Caucasian ores. Arsenic was also used as an alloy to yield brass.

Stein collected a few bronzes from Shahi Tump, Mehi, Siah Damb and Segak Mound, all of which have a high tin percentage... tin was a precious commodity as is evident from the findings of bronze scraps, stored along with other valuables in copper vessels at both Harappa and Mohenjodaro (Vats 1940: 381; Marshall 1931: 488). According to Agrawal (1971: 168) only 14 percent of Harappan tools were alloyed in the optimum range of 8 to 12 percent tin. Furthermore tin bronze is more abundant (23 percent of the tools) in the upper levels of Mohenjodaro than in the lower levels (6 percent)... Tin deposits known in India are located in Palampur region of Maharashtra, Dharwar district in Karnataka and Hazari Bagh District of Bihar (Marshall 1931: 682). Bhilwara in Rajasthan and Hosainpura in Gujarat are also known to have a limited quantity of tin (Chakrabarti 1979: 70). Outside India, on the western frontier, tin is known to occur in Kuh Banan, Karadagh and Khorasan (Marshall 1931: 483-484; Vats 1940: 378-82) between Astrabad and Shah Rud in Iran (Gowland 1912) and between Bukhara and Samarkand in Soviet Central Asia (Crawford 1974; Masson and Sarianidi 1972: 128)... The main supply of tin may... have come from the western regions: Khorasan and the area between Bukhara and Samarkand (Chakrabarti 1979: 70) through sites like Shortugai... **Tin was one of the commodities which the Sumerians got from Meluhha** (Leemans 1970; Muhly 1976: 306-307)... it is possible that tin was basically a trading item which the Harappans were obtaining from Khorasan and Central Asia for export to Mesopotamia, just as they obtained lapis lazuli from Badakshan for export there.



Seal from Shortugai incised with an antelope and two other pictographs. "…Shortugai in Oxus basin, on the Kokcha-Amu Darya doab, has revealed the existence of a Harappan colony for carrying out trade in lapis lazuli. Apart form typical Harappan pottery, a seal bearing the script has also been found to confirm the trading character of the colony." (Six decades of Indus Studies in: BB Lal and SP Gupta, eds., Frontiers of the Indus Civilization, Fig. .8, p. 9].

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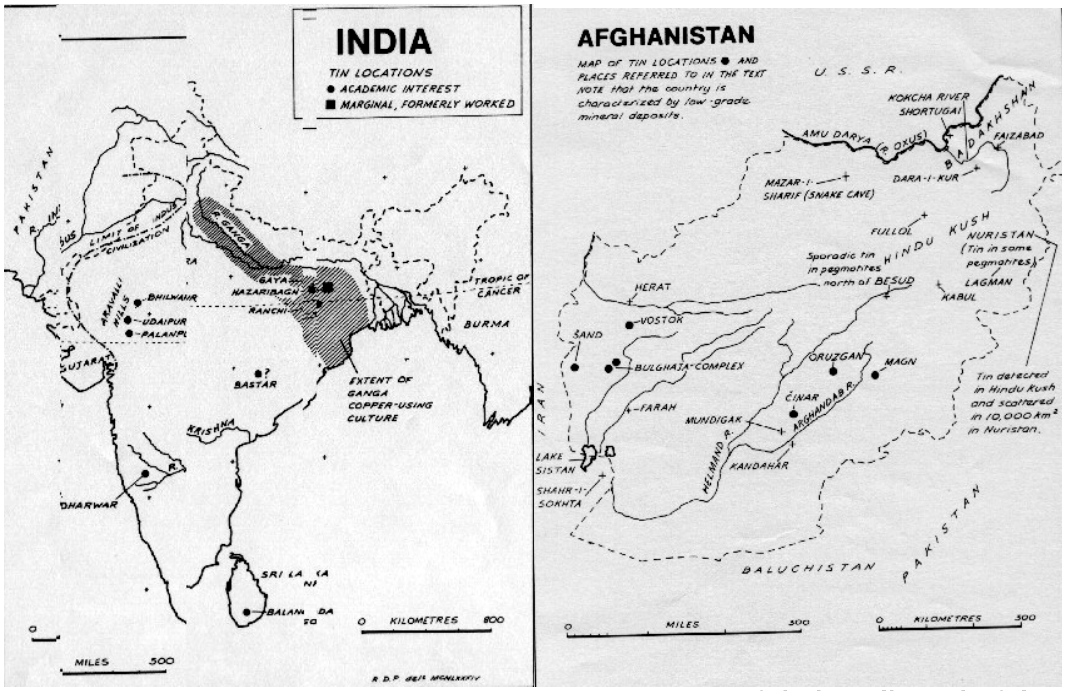
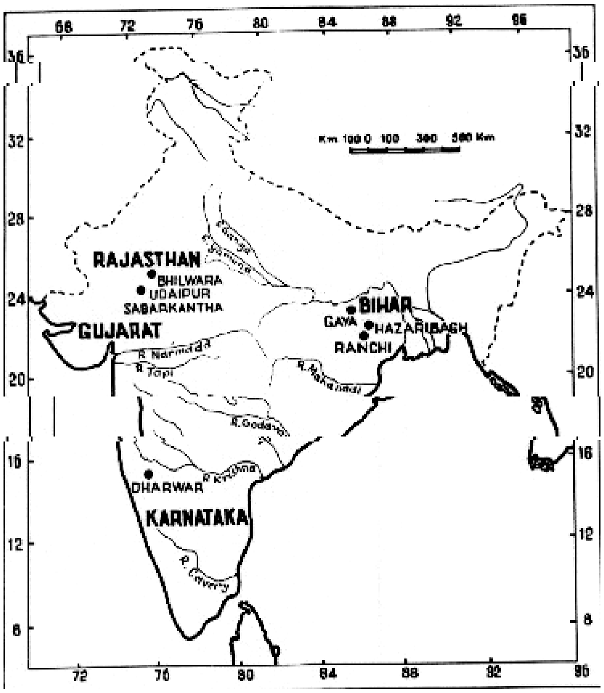


Sources of tin in India and Afghanistan (After Pennhallurick, 1986, maps 3 and 5).



Sites of Indian tin ore deposits (Fig. 2, Hegde, opcit.)

"Tin ore deposits are known to occur in India at a number of places in Rajasthan, Gujarat, Bihar, and Karnataka. In Rajasthan, they are found in the Aravalli Hills, about 27 km north of Shahapura, near Paroli in Bhilwara district and at Soniana in Udaipur district. In Gujarat, the deposits occur within the Aravalli Hills, near Hussainpur and Palanpur, in Banaskantha district. In Bihar, tin ore deposits are reported from the Chota Nagpur Hills, in Hazaribagh, Ranchi, and Gaya districts. In Hazaribagh district, they are found at Simritari, Pihra, Chappatand, and at Nurungo. In Ranchi district, the deposits are foundat Jonha Silli and Paharsingh. In Gaya district, they are found at Dhakanahwa and Dhanras. In Karnataka, small cassiterite deposits are reported to be present in the alluvia of the streams flowing from the northern part of the Kapatgod Hills, near Dambal in Dharwar district....Cassiterite is often found in the form of water-concentrated deposits, referred to as 'stream tin'. R.F. Tylecote (1962, *Metallurgy in Archaeology*, London, Edward Arnold, p. 63), observes more likely that it was stream tin that the ancient metallurgists exploited rather than vein deposits. Vein deposits are hard to mine. Proper prospecting of the alluvial deposits of the streams that

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flow from the cassiterite-bearing hills in the Aravalli and Chota Nagpur ranges, is yet to be done...tin ore deposits within the proximity of the Aravalli and Chota Nagpur Hills and whether they did not form a source of ancient tin India. Our study on the source of ancient Indian copper seems to indicate this possibility. Through a spectrometric analysis and comparison of impurity patterns, we have been able to demonstrate the possibility of linking the copper in the post-Harappan copper and bronze objects with the chalcopyrite deposits in the Aravalli Hills. The chalcopyrite deposits in the Aravalli Hills form a discontinuous belt, extending over 150 km. And within the belt, there are a number of 7 to 8 m deep shafts and large slag heaps -- possible marks of ancient mining and metal-smelting activities. Among the excavated material remains, dated to ca. 1500 BCE from Ahar, a site within the Aravalli Hills, there were a number of chunks of semi-fused glass-like material. This we have chemically analyzed and identified as copper metallurgical slag, a waste product of the copper smelting industry. We have therefore observed that Ahar was an ancient Indian copper smelting center. The metalworkers there appear to have exploited the locally available ores. Similarly, in Bihar chalcopyrite deposits occur at a number of places, in Hazaribagh and Singhbhum districts in the Chota Nagpur Hills. These deposits are also marked with ancient metalworking activities. In the Aravalli and Chota Nagpur Hills copper and tin ore deposits occur in proximity. There are clear indications to show that the ancient Indian metallurgists exploited the copper ore deposits occurring in the Aravalli Hills. It is likely that they took advantage of the copper ore deposits in the Chota Nagpur Hills, as well...The geographic distribution of sites, where ancient Indian bronze objects were found, supports this observation. However, this does not rule out the possibility of import of tin into India. India has had long cultural and trade contacts with Burma, Malaya and other Southeast Asian countries known for their rich deposits of tin ore. These contacts increased during the historic period...C.J.Brown and A.K. Dey (1955, *India's Mineral Wealth*, Bombay, Oxford University Press, p. 167) refer to the fact that in 1849 tin ore was being smelted in village iron furnaces at Purgo, near Parasnath in Bihar. It is therefore likely that the locally smelted tin and imported tin were both used in the production of ancient Indian bronze objects." (K.T.M. Hegde, Sources of Ancient Tin in India, in: Alan D. Franklin, Jacqueline S. Olin and Theodore A. Wertime, eds., 1977, *The Search for Ancient Tin*, Washington D.C., US Government Printing Office).

"Important copper mines of Rajasthan being those at Khetri and Singhana in the Jhunjhunu district and Kho-Darbia in Alwar District. An organic sample from Dariba has been dated by C14 to ca. 360 BCE. In Bihar there are important mines of copper at Rakha and Mosabani in Singhbhum district. The copper belt is about 100 miles in length and is marked by many ancient workings". (Bharadwaj, H.C., 1979, *Aspects of Ancient Indian Technology*, Delhi: 94).

"The Early Bronze Age of the 3rd millennium B.C. saw the first development of a truly international age of metallurgy... The question is, of course, why all this took place in the 3rd millennium B.C... It seems to me that any attempt to explain why things suddenly took off about 3000 B.C. has to explain the most important development, the birth of the art of writing... As for the concept of a Bronze Age one of the most significant events in the 3rd millennium was the development of true tin-bronze alongside an arsenical alloy of copper... That such (arsenic alloy) ingots would be silver in color and were therefore known as annaku in Akkadian and d'm in Egyptian (E.R.Eaton and H. McKerrell, World Archaeology 8 (1976): 179f.) is extremely unlikely because the former means 'tin' and the latter 'electrum'... Many theories have been presented to account for the spread of metallurgy in the 3rd millennium B.C., through Beaker Folk in the west, torque-bearers in Europe and the Eastern Mediterranean, and Khirbet-Kerak people in the Near East, as well as Cycladic colonists in Iberia and Trojan prospectors in eastern Europe. Such theories involve large-scale migration of peoples over vast distances, migrations often identified with one ethnic group such as Indo-Europeans or Hurrians. It is probably best to reject all such theories, along with the elaborate archaeological reconstructions that have accompanied them. There is no evidence to support the existence of any specialized group of metalworkers in the Early Bronze Age, and it has not been possible to substantiate any theory of migration or colonization at this time. Even the famous Indo-European migration into Greece and Anatolia is in need of a comploete reinvestigation...

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(cf. C. Renfrew and R. Whitehouse, The copper age of Peninsular Italy and the Aegean, *Annals of the British School of Archaeology in Athens* 69 (1974): 343-90, p. 381)…

Now everyone, from the British Isles to India and China, emphasizes the local origins of technology developed by indigenous cultures. Surely the pendulum has swung in the opposite direction and we are seeing the extreme reaction to an equally extreme past position. The truth must lie somewhere in the middle ground... In fact the spread of tin-bronze, the other major development in copper metallurgy in this period, implies the existence of some type of long-distance trade. As there are no known sources of tin anywhere in the Aegean, the Eastern Mediterranean (apart from Egypt), or the Near East, the appearance of tin-bronze in such widely separated areas as north-western Anatolia (Troy), Cyprus (Vounous), and southern Mesopotamia (Ur and Kish) requires a network of trade routes covering a considerable area... The sources of tin being used in the 3rd millennium B.C. remain the great enigma of Early Bronze Age archaeology... The Old Assyrian letters from the Anatolian merchant colony (or ka_rum) at Kultepe, ancient Kanes', covering the period known as ka_rum II, 1950-1850 B.C. , provides extremely detailed information on shipment of loads of tin (Old Assyrian annukum) from the capital city of Assur to the members of the private business-houses residing at Kanes'... All that we know is that the tin was brought to Assur, presumably from points to the east, and from Assur shipped overland by annual donkey caravans to central Anatolia. We also know that the textiles, representing the other half of the trade goods sent to Anatolia, came from Babylonia to the south... With disturbances in the north, especially in the Zagros mountains, cutting off the trade in tin with Anatolia, Sams'i-Adad I (king of Assyria, ca. 1850-1600 B.C.) shifted his interests westward and Mari (located on the upper part of Euphrates midway between Aleppo and Baghdad) became an entrepot on a trade route that brought tin up the Euphrates to Mari... the texts are vague as to the ultimate source of this tin, but it seems to be coming from Iran by a southern route through Susa.

"Sources of Tin and the Tin Trade...The tin was brought to Asshur from some point further east, most likely Afghanistan. The Assyrian merchants purchased the tin for reshipment, by donkey caravan, and sale (at a 100 percent markup) in Anatloia...The Old Assyrian tin trade was on a large scale and enriched three generations of Old Assyrian merchant families...

"Tin exists in nature in the form of cassiterite, an oxide of tin. The cassiterite most likely utilized by Bronze Age metal workers was alluvial or placer cassiterite, popularly known as tin-stone and present as nuggets or pebbles in the beds of streams...Alluvial cassiterite was collected by panning the bed of a stream, much like the recovery of alluvial gold...Gold and tin often occur within the same general area as, for example, in the Eastern (Arabian) Desert of Egypt. Ancient Sardis, the region of the Tmolus (modern Boz Dag) mountain range and the Pactolus River, was famous as an ancient source of alluvial gold, the source of wealth for Croesus, king of Lydia, but no placer cassiterite has been documented from Anatolia...

"The similarity in geological history suggests a possible historical connection between tin and gold, with the two metals first being used at about the same time. This seems to be exactly what happened (except for the extensive use of gold in a few of the burials from the site of Varna, on the Black Sea coast of Bulgaria, dating to the second half of the fifth millennium, and the presence of eight massive, circular objects of gold and electrum in a Chalcolithic cave deposit of the fourth millennium at Nahal Qanah in Israel).

"Bronze tools, implements, and weapons and gold jewelry appear together in the Royal Cemetery of Ur, the royal shaft graves of Alaca Huyuk, and the various treasures (really hoards) of Troy II...The same is true for the bronze metallurgy and gold jewelry of Poliochni V (yellow). All this begins in the twenty-sixth century BCE, the date of the Royal Cemetery, and continues over the next few centuries down to about 2200 BCE. As indicated above, the possibility of tin, gold, and lapis lazuli coming into

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Mesopotamia from Afghanistan is certainly an attractive one. Of these three raw materials, however, we can be sure of the provenance of only one. Most, if not all, of the lapis lazuli used by the Sumerians came from northeast Afghanistan, from the Sar-i Sang mines in the region of Badakhshan...As for tin and gold, it can only be said that both metals are present in significant quantities in Afghanistan and in alluvial form. The recovery of fine gold particles from streams, making use of the woolly fleece of sheep (the famous Golden Fleece of Greek legend), was still practiced in Afghanistan well into the twentieth century.

It will be argued further, elsewhere (deciphering Soma as Electrum), that the historical between the use of tin and gold is exemplified by the metallurgical processes delineated by the artefacts of the civilization and those described in the R.gveda -- both processes occurring principally on hundreds of sites on the banks of the River Sarasvati_.

"Mari and the Tin Trade...the texts from Mari (Tell Hariri), dating mainly to the first half ot the eighteenth century BCE...(tin) came to Mari through Elam, from Susa and Anshan (now identified with the Central Iranian site of Tepe Malyan), and Elamites played a major role in the trade, especially a man named Kuyaya. Certain merchants from Mari were also heavily involved in the tin trade with Elam, among them a merchant named Ishkhi-Dagan (the two appear together in ARM 23 555). The tin came to Mari in the form of ingots (Akkadian **le_'u**) that weighed about ten pounds each. It is possible to obtain some idea of the relative value of this tin, for a number of the Mari texts provide a tin:silver ratio of 10:1 (the most common ratio; a few texts give ratios from 8:1 to 15:1). This is to be compared with isolated referenced to a tin:gold ratio (48:1), a confusing silver:gold ratio of 4:1 as well as 2:1, and a lead:silver ratio (1200:1). The usual copper:silver ratio at Mari was 180:1 for unrefined 'mountain' copper, with refined (litarally 'washed') copper being valued at 150:1. This means that tin was usually from fifteen to eighteen times more valuable than copper...In later texts from Nuzi (fifteenth century BCE) goods were priced in amounts of tin. An ox cost thirty-six minas of tin; an ass, twenty-four minas. During the Middle Assyrian period tin seems to have functioned as the monetary standard (temporarily replacing the customary silver). Plots of land were purchased with tin...

"…the Greek geographer Strabo (first century BCE) does refer to tin from Dangiana, Iranian Seistan (15.2.10), a reference that certainly could be seen within the context of an overland trade route through Shahr-I-Sokhta and Mundigak and on to Susa…

"…not one of the oxide ingots from Crete is made of Cypriot copper, all of those found outside Crete were made of Cypriot copper…This also includes all of the ingots (at least all of those tested: oxhide, bun, and slab ingots) from Cape Gelidonya and Uluburum shipwrecks. This would mean that Cypriot copper was the predominant metal for the bronze industries across the Mediterranean, from Syria to Sardinia, from about 1300 BCE on…"

The emergence of the Iron Age (c. 1000 BCE)…'The simplicity of iron-working took metallurgy out of the palace, just as the alphabet had done for the art of writing.' (p. 1517).

[James D. Muhly, Mining and metalwork in ancient Western Asia in: Jack M. Sasson, ed., 1995, *Civilizations of the ancient Near East,* New York, Charles Scribner's Sons, pp. 1501-1521].

"The cuneiform archives contain a number of 'recipe' texts, giving the amounts of coper and tin used to make specified amounts of bronze. One of the earlist such texts, from Palace G at Ebla, records that 3 minas, 20 shekels of tin were alloyed with 30 minas of copper to produce 200 objects of bronze, each weighing 10 shekels. In other words, 200 shekels of tin were mixed with 1,800 shekels of copper to produce 2,000 shekels of a 10 percent tin-bronze. In one Mari text 20 shekels of tin were added to 170 shekels of refined copper from Teima at the rate of 1:8, to produce 190 shekels of bronze for a key (to

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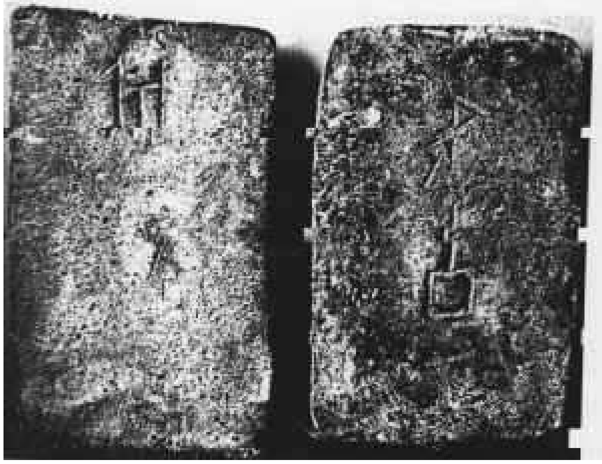
the lock of a city gate)...This means that smiths at Mari were working with the metals themselves--with copper and tin--not with ores or minerals. That is no smelting was being carried out in the vicinity of the Mari palace...

"At the other end of the Mari trade network, the texts record that tin stored at Mari was transhipped to various cities in the Levant, from Karkamish in the north to Hazor in the south. This we learn from a remarkable tin itinerary that concludes with the recording of '1 (+) minas of tin to the Cretan; 1/3 mina of tin to the translator, chief (merch)ant among the Cretans; (dispensed) at Ugarit...' (ARM 23 556). This striking passage indicates that there were Minoan merchants (the text uses the name Kaptaru, generally taken to designate the island of Crete) doing business (perhaps also residing) at Ugarit (modern Ras Shamra) toward the beginning of the Old Palace period in Crete. Furthermore, the Minoan merchants seem to have had a translator (Akkadian, **targamannum**; the origin of the common European 'dragoman') who was also the leader of the Minoans doing business at Ugarit. Such translators are known from other periods of Mesopotamian history. We have the cylinder seal of a Sargonic official who served as translator for the Melukkha merchants who came to Agade from the Indus Valley, perhaps bringing with them the tin of Melukkha, a commodity mentioned in one of the statue inscriptions of Gudea, ruler of Lagash. A Mari text, dated to the ninth year of the reign of Zimri-Lim, refers to the construction of a 'small Kaptaru boat', perhaps to be taken as a model ship for ritual purposes or as the designation of a ship built for sailing to Crete. A possible parallel for this would be the Egyptian references to Byblos ships (for sailing to the ancien Syrian port of Byblos (modern Jubayl) and Keftiu ships (built for sailing to Crete)...



"Bronze certainly was being produced in Middle Minoan Crete, with production undergoing a great expansion during the Late Bronze Age, as it did on the Greek mainland...The problem is that, at present, no satisfactory analytical method for studying the provenance of tin has been discovered." (James D. Muhly, 1995, Mining and Metalwork in Ancient Western Asia, in: Jack M. Sasson, ed. 1995, *Civilizations of the Ancient Near East*, Vol. III, New York, Charles Scribner's Sons, pp. 1501-1521).

Tin[3] used in Harappan civilization is well attested. (Hegde 1978; Chakrabarti 1979; Muhly 1985: 283; Stech and Pigott 1986: 43-4). Gudea c. 2100 BC, identified Meluhha as the source of his tin (Falkenstein 1966: i.48: Cylinder B: XIV). "...tin may well often have travelled by sea up the Gulf from distribution centres in the Indus Valley. In the Old Babylonian period tin was shipped through Dilmun (Leemans 1960: 35)... It is now known that Afghanistan has two zones of tin mineralization. One embraces much of eastern Afghanistan from south of Kandahar to Badakshan in the north-east corner of the country (Shareq et al. 1977); the other lies to the west and extends from Seistan north towards Herat (Cleuziou and Berthoud 1982), the valley of the Sarkar river, where the hills are granitic. Here tin appears commonly as cassiterite, frequently associated with copper, gold, and lead, and in quantities sufficient to attract attention in antiquity. Bronzes at Mundigak, and the controversial Snake Cave artefacts, indicate local use of bronze by at least the third millennium BCE (Shaffer 1978: 89, 115, 144). A number of scholars have pointed out the possibility that tin arrived with gold and lapis lazuli in Sumer through the same trade network, linking Afghanistan with the head of the Gulf, both by land and sea (Stech and Pigott 1986: 41-4)." (Moorey, 1994, opcit, p. 298-299).

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Ancient trade in tin

“There is also some indication that Elamites were involved in the trade... The tin was shipped to Mari in the form of ingots (Akkadian le_'u) and there stored in various parts of the palace known as abu_sum (storeroom), the bi_t kunukki (seal-house), and the kisallu (courtyard)... More evidence on the copper trade comes from Old Babylonian Ur, where the excavator, Sir Leonard Woolley, uncovered the house of Ea-na_s.ir, a merchant who specialized in the trade in copper, located at what Woolley called No. 1 Old Street. A number of texts found in the area and dating to the reign of Rim-Sin, king of Larsa (1822-1763 B.C.), record Ea-na_s.ir's activities in the copper trade, which consisted of importing what is called Tilmun copper... called Magan copper in earlier periods, which was shipped to Mesopotamia up the Persian Gulf. [A. Leo Oppenheim, The Seafaring Merchants of UR, *JAOS* 74 (1954): 6-17, and J.D. Muhly, 1973, Copper and Tin, Conn.: Archon., Hamden; *Transactions of Connecticut Academy of Arts and Sciences*, vol. 43) p. 221f.]... However, the shipment of tin all the way from Iran to southern Mesopotamia and up the Euphrates to Ugarit and beyond to Crete represents a trade route of epic scope... the so-called Dark Age lasting from ca. 1600 to 1400 B.C... saw the establishment of the Hurrian kingdom of Mitanni, with its Indo-Aryan background (T. Burrow, The Proto-Indo-Aryans, 1973, Journal of the Royal Asiatic Society, 1973: 123-40)... the recipes for making bronze contained in many Bronze Age cuneiform texts. The following text from Mari is a good example: (Text is G. Dossin: Archives de Sumu-lamam, roi de Mari, RA 64 (1970): 17-44, esp. 25, text n.6. The specification te-ma-yu which appears in several texts from this archive, is really of unknown meaing). Here the proportions are quite exact: 20 shekels of tin is added to 170 shekels of copper (almost 1:8) to make exactly 190 shekels of bronze. This means that there was a fair amount of metallic tin in use during the Late Bronze Age. By ca. 1400 B.C. tin was being used in Greece to cover clay vases destined for the grave, in order to make them look like silver, and to line ivory cosmetic boxes to keep the ivory from being stained by the rouge or ointment placed inside..."

1.1/3 MA.NA AN.NA
2. a-na 2 5/6 MA URUDU.LUH.HA
3.TE-MA-YU
4. i-na 8 GIN.TA.AM ba-l[i-e]l
5. SU.NIGIN 3 MA.NA 10 GIN ZABAR
6. a-na nam-za-qi-im

1/3 mina of tin to 2 5/6 minas
of washed copper from
Tema (?) has been alloyed
at the ratio of 8:1
Total: 3 minas, 10 shekels
of bronze for a key

"According to ratios given in the texts tin was very cheap, as high as 240:1 and 180:1 in a tin/silver ratio. What is curious is that bronze was twice as expensive as tin, for a text says of a payment that 'if (paid) in tin (it should be) at the ratio of four minas (of tin) per (shekel of silver), if in bronze at the rate of two minas.' (Text is Harvard Semitic Studies (HSS) XIV as quoted in Chicago Assyrian Dictionary (CAD), s.v. annaku, 129a). This seems to indicate a great increase in the amont of tin in circulation during the period 1500-1300 B.C... One text even refers to an alloy (Akkadian billatu) composed of 1 mina of copper and 8 1/2 shekels of tin, giving a ratio of 7:1. (Text is

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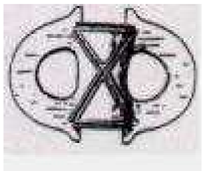
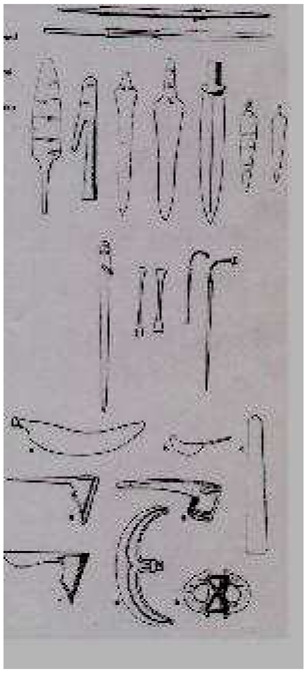
Keilschrifttexte aus Assur verschiedenen Inhalts 205, quoted in CAD, s.v. billatu, 226a.) In the Old Assyrian period one text gives a ratio of 8:1 (4 minas of copper, 1/2 mina of tin, the metal being destined for the smith, Akkadian nappa_hum)(Text is Cuneiform Texts from Cappadocian Tablets in the British Museum (CCT) I 37b, quoted in CAD, s.v. annaku, 128a.)

(See J.D. Muhly, New evidence for sources of and trade in bronze age tin, in: *The Search for Ancient Tin* , Washington, D.C., Smithsonian Institution Press, 1978, pp. 43-48)(James D. Muhly, The Bronze Age Setting, in: Theodore A. Wertime and James D. Muhly (eds.), 1980, The Coming of the Age of Iron, New Haven, Yale University Press, pp.25-67.)



Crescentic battle-axe unearthed from an Ur tomb (Seton Lloyd, *The Archaeology of Mesopotamia*, London, Thames and Hudson, p. 126: Weaponry in Mesopotamia (Early Dynastic levels at Sumerian sites 2500-2016 B.C.) This battle-axe is one of the weapons unearthed from Ur sites.



Weaponry in Mesopotamia (Early Dynastic levels at Sumerian sites 2500-2016 B.C.): "(The products of metalsmiths), in the form of weapons, implements and utensils, have survived in great numbers, side-by-side with pictorial representations of the purposes for which they were used. In a well-known relief, spears, shields and helmets of copper are to be seen; in another battle-axes; 'guardian' figures in seal designs wield daggers with crescent-shaped handles; 'rein-rings' with their animal mascots appear on chariots in battle-scenes; and at a 'banquet' copper 'drinking-tubes' are used.")

Metal tools and weapons from Ur tombs

***Top row*: tanged and ribbed spearheads; *second row*: leaf-shaped spear-head, harpoon, knives and daggers; *third row*: drill-bits, straight and curved pins with eyeleted shanks; *bottom row*: a and b, scrapers; c, chisel; d and e, socketed adzes and f, axe cast in a two-piece mould; g and h, crescentic battle-axes.**

"...there is no record as to what Sumer delivered to Meluhha...Connections between Sumer and Dilmun are obvious in both directions, especially from seals; gulf seals in Hili (United Arab Emirates) and Lothal demonstrate the contact between Dilmun and Makan or the Indus Valley civilization. The stone weights found by Bibby in Qalhat al-Bahrain (Bibby, 1970: 372, pl. 18b) prove that far-reaching influence of the Indus Valley in the organisation of commerce in Dilmun by the use of its weights system, together with the original stone weights... site near the village of Al-Maysar... The (copper) ingots have a bun-shaped form which is typical of the third millennium BCE and occurs from Tell Chuera in Syria throughout Mesopotamia to Lothal in India (Moorgat and Moorgat-Correns, 1978; *Memoires de la Mission Archeologique de Perse,* 25: 190, fig. 21; Rao, 1963)...

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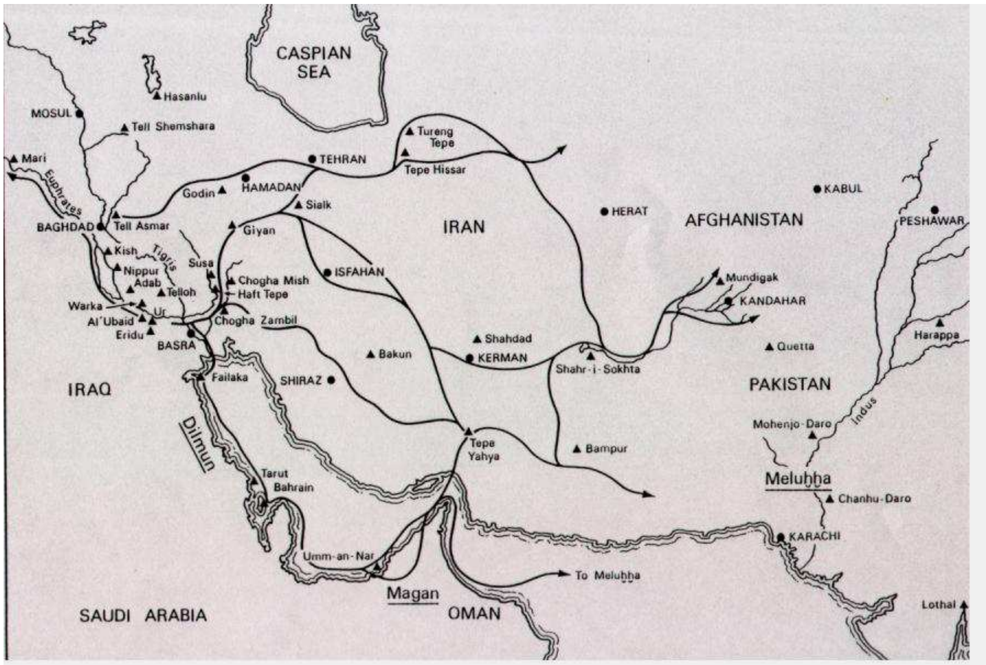

"The main importance of a seal found in 1980 in Maysar-1 (Weisgerber, 1980), is the fact that the Makan/Oman civilisation used seals, as did the great cultures of the Nile, Euphrates/Tigris and Indus. But it is also a convincing proof of contact between Meluhha and Makan. On three sides six animals are engraved: two caprides, an ibex and a wild goat; a zebu cow and a scorpion; a dog and again a wild goat. In our context the zebu cow is the most important. Together with the humped bull painted on a jar from Umm an-Nar (Bibby, 1970: 280) it demonstrates the presence of these animals in the Oman peninsula during the third millennium BCE. This again proves contact with India.

Hajjar, Bahrain. Triangular prismatic seal (Bahrain National Museum)

"A new seal from Hajjar in Bahrain now gives the same evidence, its shape being nearly identical with the Maysar-1 seal. Among its three engravings are a short-horned bull and an insription in Indus Valley script (Weisgerber, 1981: 218, fig. 54)." (Gerd Weisgerber, Makkan and Meluhha--third millennium BCE copper production in Oman and the evidence of contact with the Indus Valley, in: Parpola, Asko and Petteri Koskikallio (eds.), *South Asian Archaeology 1993*, Helsinki, Suomalainen Tiedeakatemia, 1994).

"The carbonate minerals of copper, malachite and azurite, have long been used as semiprecious stones and as pigments (for green and blue, respectively)...It is always important to distinguish between mineral and metal. The carving of malachite as a semiprecious stone has nothing to do with copper metallurgy. Nor does the use of hematite (iron oxide) in Chalcolithic maceheads and Old Babylonian cylinder seals have anything to do with iron metallurgy...The earliest massive copper artefact from the ancient Near East is probably the copper macehead from level 2B at Can Hasan, in southern Anatolia, dating to about 5000 BCE...From about 5000 BCE the site of Tall-i-Iblis, in southern Iran, has produced an array of small bowl furnaces and crucibles that have been associated with copper smelting.

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"Copper Workshops. The best example of a pre-Bronze Age copper workshop is probably that from period II9 at Tepe Ghabristan (just west of Tehran), dating to about 4500 BCE. Excavations there yielded crucibles, molds, a tuyere, some sort of furnace, and a deep bowl with more than twenty kilograms (about forty-five pounds) of copper ore in nut-sized pieces. A copper workshop from late Ubaid levels at Degirmentepe, on the upper Euphrates and dating to about 4000, is known only from brief preliminary reports, as is the copper workshop from Chalclothic Nors'untepe in Keban area of southeastern Turkey...

"In Iran the site of Susa (modern Shush) has yielded a wealth of metal finds, including a collection of fifty-five large and small flat axes, chisels, pins, and flat mirrors, made of copper or arsenical copper and dating to about 4000...There is also some evidence to indicate that by the late fourth millennium BCE, Mesopotamian metalworkers were experimenting with different alloys. A small lion figurine from Uruk (modern Warka), of the late Uruk or Jamdat Nasr period, was found to contain 9 percent lead; and an unusual type of arrowhead from the Riemchen Building at Uruk contained more than 25 percent silver.

"Various workshops for copper (and bronze) metallurgy have been identified in Mesopotamia, but nothing very convincing before the early second millennium BCE. From that period, workshops were spread over a wide area including the ka_rum Kanesh (modern Kultepe), level Ib (southern Anatolia), Tell Sweyhat (Syria), and Tell edh-Dhiba'i (suburb of Baghdad). Tell edh-Dhiba'i produced an impressive array of crucibles, molds, tuyeres, and pot bellows...In the early third millennium the Sumerians, for no obvious reason, are thought to have switched to copper from Oman, an area known to them as the land of Magan (as it was to the Greek geographer Ptolemy (second century CE), who knew the region of the Persian Gulf as the Mago_n kolpos). Iranian metallurgy continued to develop during the course of the third millennium, but it is possible that the development of Gulf trade, resulting in the establishment of contact with Harappan civilizatin of the Indus Valley, prompted a Mesopotamian shift from Iran to more convenient (perhaps more accessible) sources of copper in Oman. It is also possible that an Iranian (or Elamite) shift in focus to the Central Asian lands of Bactria and Margiana cut off Mesopotamian access to the copper deposits of Iran, forcing the Sumerians to seek new sources of copper...

"The Bronze Age exploitation of the Omani copper deposits seems to have coincided with what are most likely two related phenomena: (1) references in Mesopotamian texts to copper from Magan and to obtaining that copper either directly from Magan or through the intermediate agency of Dilmun (the island of Bahrain)-- the copper did not come FROM Dilmun but THROUGH Dilmun; and (2) the period of the Mature Harappan phase of the Indus Valley Civilization.

"This second correlation suggests that contact and trade with Mesopotamia were factors contributing to the development of the Indus Valley civilization, established in an area known to the Sumerians as the land of Melukkha. So close was the relationship that the traders of Dilmun used the same system of weights and measures as that found in the Indus Valley. From the figures given in Sumerian texts it would appear that the Dilmun shekel was about three times heavier than the standard Sumerian one. It has been thought by some scholars that transactions at Ebla (modern Tell Mardikh) were also conducted on the basis of the Dilmun shekel, but this reading of the sign in question in the Ebla texts cannot be substantiated, and all theories regarding references to Dilmun at Ebla remain conjectural.

"The amount of copper involved in this trade was quite considerable. One text from Ur (UET 5 796), dated to the reign of Rim-Sin of Larsa (1822-1763 BCE), records the receipt in Dilmun of 611 talents, 6 2/3 minas of copper (presumably from Magan). This shipment, according to the text, was weighed according to the standard of Ur, giving a modern equivalent of 18,333 kilograms (40,330 pounds) of copper. One-third of this copper was earmarked for delivery to Ea-na_s.ir of Ur, a merchant who had close connections with Magan and the Dilmun copper trade...**This contact beween Metopotamia and**

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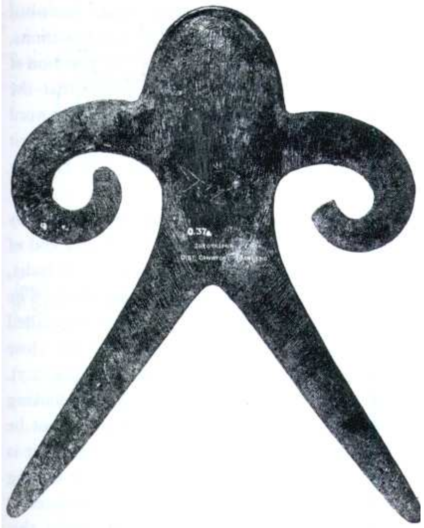
the Indus Valley, the land of Melukkha, was clearly by sea and must have brought products across the Arabian Sea and the Persian Gulf. These products included the copper of Magan. Did they also include the tin of Afghanistan and Central Asia, perhaps the tin designated by Gudea, king of Lagash (now known to be a contemporary of Ur-Nammu, king of Ur, circa 2100 BCE), as the tin of Melukkha?" (James D. Muhly, 1995, Mining and Metalwork in Ancient Western Asia, in: Jack M. Sasson, ed. 1995, *Civilizations of the Ancient Near East*, Vol. III, New York, Charles Scribner's Sons, pp. 1501-1521).

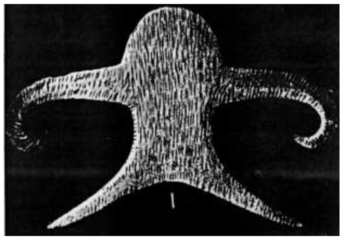
Industrial Revolution of the Bronze Age, centering in the use of fire

Pa_n.ini states in As.t.a_dhya_yi that tools and implements made of copper and other metal were used by a metal smith. (*As.t.a_dhya_yi*, 2nd edn., Varanasi, 1963, p. 234). Patanjali (Maha_bha_s.ya) comments on Pa_n.ini's su_tra - jivika_rthe ca_pan.ye (v.3) that the Mauryas had made images of Gods for obtaining gold. The reference is perhaps to metal images. (Kielhorn, ed., *Maha_bha_s.ya*, vol. II, Bombay, 1906, p. 429; see also J.N.Banerjee, *Develoment of Hindu Iconography*, p. 44).

Gungeria in present day Madhya Pradesh yielded a unique hoard of some 526 copper and silver objects (copper objects 376.02 kg; silver objects 0.93 kg). S. Piggott characterized the copper hoard people as food-gathering tribesmen with an economy centred on fish-spearing (1st half of second millennium (Piggott, S., 1944, 173-182) and as "refugees and displaced persons" from the Punjab and the Indus valley (Piggott, S. 1950, 238).



Copper anthropomorph found at Sheorajpur, Dist. Kanpur, U.P. a fish sign is inscribed on the chest. Lucknow Museum (nos. 348-350). The curved 'hands' are reminiscent of the curved horns of a ram; weight range of similar objects: ca. 3000-6000gms.; height range: 30.2 -47.9 cm. Some anthropomorphs weigh over 6 kgs. A hoard at Ghangaria also yielded sheet-silver bull's heads and discs. It is possible that the anthropomorph represented a votive deposition of metal riches, in ingot-like form. (cf. Paul Yule, 1997, The copper hoards of Northern India, *Expedition*, Vol. 39, No. 1, p. 32). The inscribed 'fish' sign may yield a clue, if this is 'read' consistent with the readings of the earlier 'Harappan script' signs denoting a fish and variants of the 'fish' signs. Most of the hoard objects are of non-alloyed copper.



Anthropomorph. Copper. Bisauli, Allahabad Museum.

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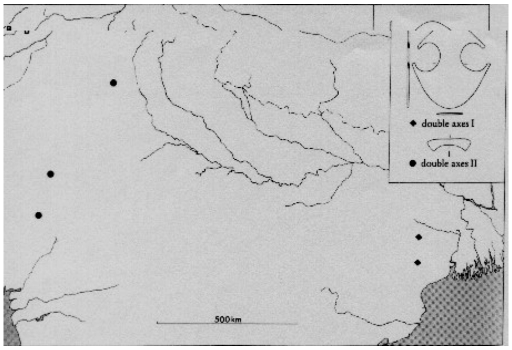
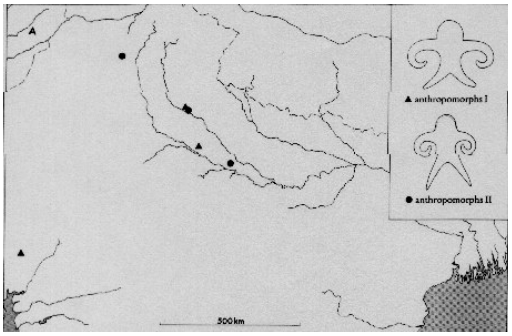
So far 20 anthropomorphic figures of copper have been reported. One type is between 23.2 to 24.1





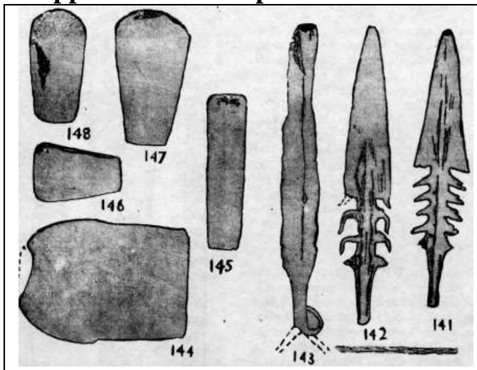
cm. High with long curving arms (horns?) and average weight of 1,260 grams.

Distribution of anthropomorphs in the Ganga-Yamuna doab

Distribution of double axes in the Sarasvati River Basin (After Plate 102 in: Yule, 1985, opcit.)

B.B. Lal published 35 hoard objects -- shouldered axes, bar celts, rings, harpoons, antenna swords and anthropomorphic figures -- from a dozen findspots in the Ganga-Yamuna doab. (Lal, B.B., 1951, 20-39). "Lal also raised the question, whether the authors of the Hoards possibly were not related to the later inhabitants of the area, i.e. the Proto-Australoid Mundas, the Santals and other tribes. Dark-skinned, short of stature and with flat noses, these tribesmen conceivably are the latter day successors of the Nishadas described in the Vedas, who the invading Aryans encountered on reaching the plains of the northern part of the subcontinent. Difficult to substantiate is Lal's theory that 'Neolithic' bar celts in stone, which resemble metallic bar celts and bar celt-ingots from Madhya Pradesh and eastern Chota Nagpure, are the prototypes of the pre- or non-Aryan Copper Hoards...in terms of the metal technology and artifact form, the culture on the subcontinent seems in essentials to have an individual character and to be free of tangible foreign influence..." (Paul Yule, 1985, Metalwork of the Bronze Age India, Munchen, C.H. Beck'sche Verlagsbuchhandlung, p.3).

Copper Hoard Weapons: autochthonous evolution and links with Sarasvati civilization



Copper hoard weapons. National Museum, New Delhi. [After Figs. 4 to 48 in GN Pant, 1978]. These eight weapons were acquired in
965. Fig. 4 . Double-barbed harpoon with straight barbs; one knob has a hole. Fig. 42. Double-barbed harpoon with curved barbs; 37 cms. Long. Fig. 43. Antennae sword. Two holes at the base on either side of the medial ridge. 47 cms. Long. Fig. 44. Shouldered celt with two short kinks; 2 cms. Long. Fig. 45. Long flat celt; 20 cms. Long. Fig. 46. Triangular flat celt with straight cutting edge; 0.5 cms. Long. Fig. 46. Triangular flat celt with crescent-shaped cutting edge; 6.5 cms. Long. Fig. 48. Oval flat celt with rounded cutting edge; 4 cms. long.

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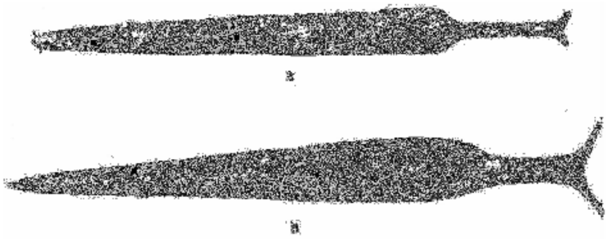
Shahabad (UP). 2nd millennium Bce. National Museum, New Delhi. Long, tapering, double-edged, pointed sword with a strong, medial rib. The hilt bifurcates like the antennae of an insect hence it is called ‘Antennae sword’. The two projections (one missing) of the hilt are bent and touching he pommel. At the base of the hilt are two holes, on on each side of the medial ridge. 47 cms. Long. [After Plate III, GN Pant, 1978]



Antennae-hilted copper swords. A. From Bactria, northern Afghanistan; 52 cm. B. From Fatehgarh, Uttar Pradesh, India. Gangetic copper hoards. 63.5 cm. [a. After Sarianidi, 1986, *Die Kunst des alten Afghanistan*. Leipzig: fig. 75; b. DH. Gordon, 1960, *The prehistoric background of Indian culture*, Bombay: pl. 27b]

Since many copper hoard weapons were found isolated discoveries and not related to stratigraphically determined excavation sites, the dating of these finds has been problematic. The weapons found in (Kaushaya, Himi, Pondi, Gungeria and Dunria) Bengal, Bihar, Orissa and eastern Madhya Pradesh included: lat celts, shouldered celts, bar celts, chisels and rings. The techniques used include: forging, hammering and rudimentary casting; the weapons follow the patterns and styles of stone tools of the Neolithic period indicating that this zone represented the original home of the copper industry in Bha_rata. In addition to these weapons, antennae-hilted swords, hooked spear-heads, harpoons and anthropomorphic figures were found at Rajpur Parsu, Sirthauli, Sheorajpur and Mainpuri (of the Yamung-Ganga Doab and Uttar Pradesh). The weapons of this region show some improved techniques of casting, cutting and notching. A few weapons have also been found in the chalcolithic contexts in about 12 sites in Rajasthan, Gujarat, Malwa, Deccan and Mysore; a few new types of weapons are also noticed in this zone: curved axe-blade and single splayed-sided axe-blade. The finds in securely dated strata are related to the late Harappan or post-Harappan chalcolithic cultures. BB Lal’s analysis of the anthropomorphic figure from Bisauli showed 98.77% copper content (BB Lal, 1951, p. 24). Smith found four implements to be bronze:

Celt from Jabalpur with 13% tin
Elliot Sword (No. 634, 3.83; Natural History Museum, Edinburgh) found at Fatehgar; it is also called a hooked spear-head. [Walter Elliot Smith describing a similar weapon called it a ‘sword’.]
Harpoon of the Ganga Basin (Norham Castle, UK): 7.97% tin
Elliot Harpoon.

DP Agarwal’s views, based on spectroscopic and metallographic analyses of many copper hoard artifacts, are that there was little evidence of alloying but the techniques included close-casting (without cold working or annealing) and based on pure copper. Mackay found six implements (dagger, knives and dirks) with mid-ribs at Mohenjo-daro. These are comparable to the technique of mid-rib implements in Shah Tepe, Iran and Afghanistan. There are two spear-heads found at Harappa with mid-ribs. There is, therefore, a possibility that the Copper Hoard workers and Harappan workers had contacts. Implements with raised mid-ribs have also been found at post-Harappan chalcolithic contexts at Navadatoli, Chandoli and Daimabad.

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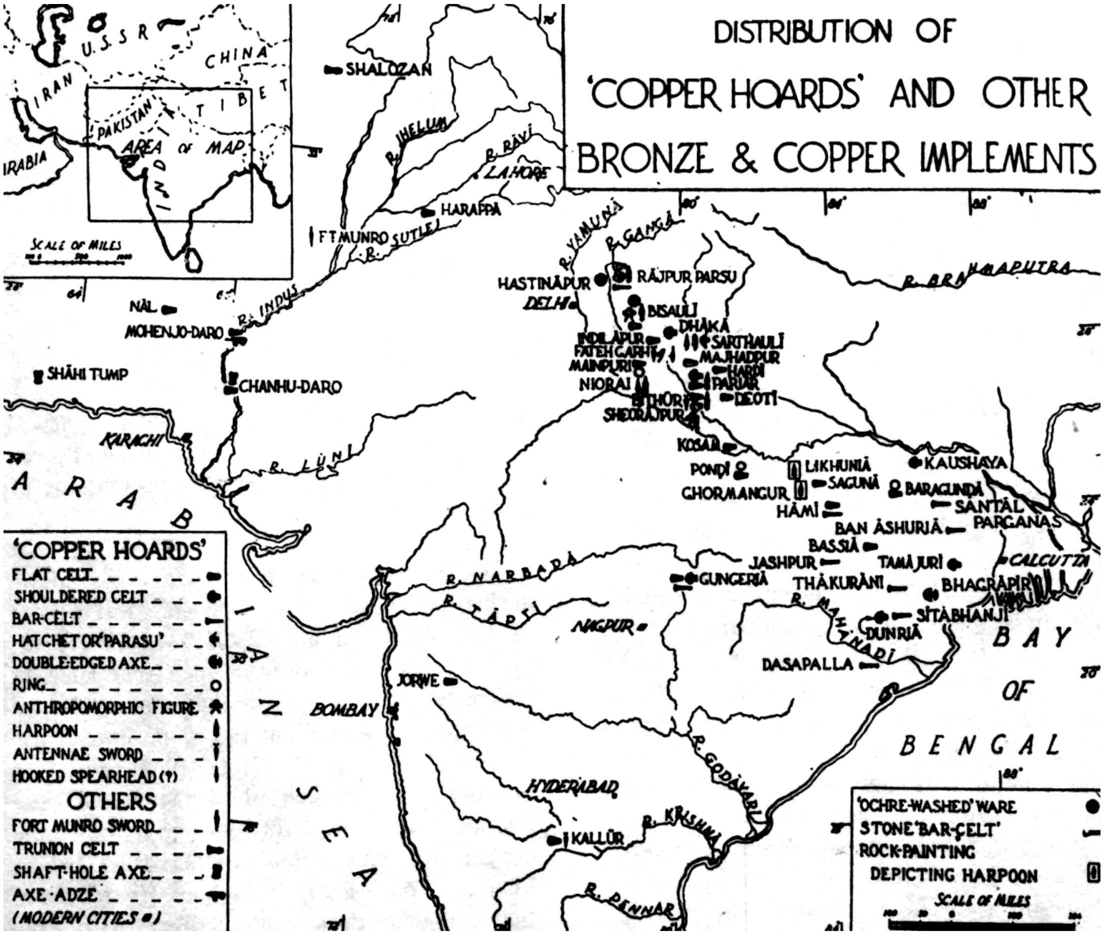

Copper hoard and other weapons. Find spots. Map after BB Lal, 1951.

Vincent Smith, BB Lal and SP Gupta have made a survey of the copper hoard weapons discovered since 1822 CE in an extensive area from Bengal to Uttar Pradesh, from Rajasthan to the Deccan, with pronounced concentration in the Ganga plains reaching upto Chhota Nagpur and Ranchi in Bihar. [Vincent A. Smith, 1905, The copper age and prehistoric bronze implements of India, *Indian Antiquary*, XXXIV, pp. 229-44; 1907, XXXVI, pp. 53-55; BB Lal, 1951, Further copper hoards from the Ganga Basin and a review of the problem, *Ancient India*, No. 9 (Jan, 1951), pp. 20-39; SP Gupta, 1963, The copper hoards: the problems of homogeneity, stages of development, origin, authorship and dating, *Journal of the Bihar Research Society*, vol. 49, pp. 1-7; cf. vol. 51 (1965)]. Hiranand Shastri reported on the discovered including antennae swords from Bithur, Bulandshahar and Hardoi. (H. Shastri, 1905, Recent additions to our knowledge of the copper age antiquities of the Indian Empire, *Journal of Asiatic Society of Bengal*, New Series, XI, pp. 1-16.] Similar weapons were reported from Bihar by Coggin Brown, Campbell and Roy. [J. Coggin Brown, 1915, *Journal of Bihar and Orissa Research Society,* Vol. I, pp. 127-28; A. Campbell, 1916, *Journal of Bihar and Orissa Research Society,* Vol. II, pp. 85-86; S.C. Roy, 1916, *Journal of Bihar and Orissa Research Society,* pp. 482-483]. Three antennae sword specimens from Hyderabad were published in the *Annual Report of the ArchaeologicalDepartment, HEH the Nizam's Dominion for 1937-40*, 1942, Calcutta, pp. 22-24. Further analyses were made by Piggott and Helden-Geldern. [Stuart Piggot, Prehistoric copper hoards in the Ganges Basin, *Antiquity*, No. 72, pp. 173-182; R. Heine-Geldern,

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Archaeological traces of the Vedic Aryans, 1936, *Journal of Indian Society of Oriental Art*, IV, pp. 87-113; 1937, New light on the Aryan migration to India, *Bulletin of American Institute for Iranian Art and Archaeology*, V (June 1937), pp. 7-16; 1956, The coming of the Aryans and the end of the Harappa civilization, Man, Vol. LV (October, 1956), pp. 136-40]. BB Lal questions Heine-Geldern's conjectures and notes the differences between the objects which had parallels with western regions and those found in the Ganga plains. Geldern's analysis is incomplete because the implements from Koban (which he claims to be an example of foreign influence on the copper age of Bha_rata) have the hilts and blades separately whereas the specimens found in Bha_rata have the hilts and blades cast in one composite piece. The dagger from Bithur with blunt antennae has a comparable specimen from the Koban dagger (Museum of St. German). Here also, the hilt and handle are separate pieces joined subsequently in the Koban specimen while the Indian specimens have ridged cross-section and a hole to tie to a shaft-pole. The hilt and the blade of the Indian specimens are a single cast. One specimen from Shahabad, UP has two holes on either side of the medial-rib. Thus the antennae swords displayed in the National Museum, Delhi, are indigenously evolved weapons of Bha_rata and unrelated to barbed types of other western regions.

Antennae swords. National Museum, Delhi (After SP Gupta, 1963]. Thirteen antennae swords out of a total of eighteen have been found at Fatehgarh. One has been found at Bithur and four swords of the Museum have been purchased from a dealer in Mehsana, Gujarat.

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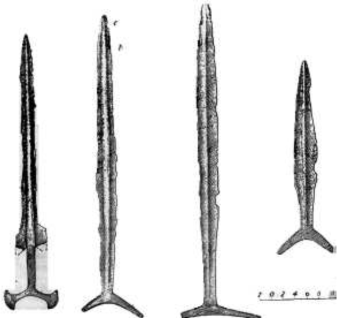

Geldern rightly notes that the two harpoons found from Ganga-Yamuna doab and Maitathal in Chautang valley are of indigenous origin:

Harpoon from Sarthauli and Bisauli. 2nd millennium BCE. National museum, New Delhi. [After Pls. I and II, GN Pant, 1978]. The Bisauli harpoon is 17 inches long; has a strong medial-rib and a long, tapering blade. The middle part has three pairs of barbs which are incurved and pointed. A pair of knobs is seen at the junction of the barbed portion with the tang; one of these knobs has a perforation (also called 'eye') and this is used to tie the harpoon to the shaft. The weapon was originally cast and later hammered. The specimen from Sirthauli indicates that the barbs wwere cut out from the blade and sharpened by filing. (BB Lal, 1951, p. 25). [Figures 98 and 99 after GN Pant, 1978]. The simple barbed weapons from Transcaucasia, Talish and Luristan (Iran) could not have inspired these harpoons found in Bha_rata. No trace of any movement of similar weapons has been identified archaeologically. Harpoons have been found in six sites in UP (Pariyar, Bithur, Rajpur Parsu).

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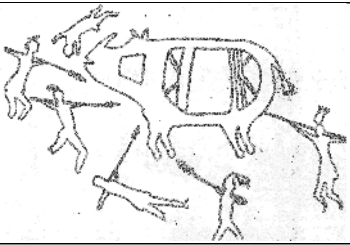
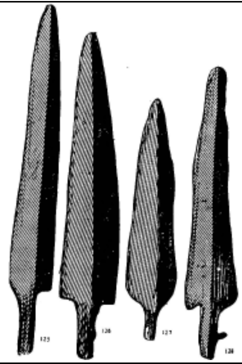


On the contrary, the harpoon specimens compare with the **cave paintings of Gharmangur, Dist. Mirzapur, Uttar Pradesh**. Rhinoceros hunt. Ghormangpur cave, Mirsapur (UP); the barbed harpoons were perhaps hafted in wooden poles to be used as spears. (After BB Lal, 95).

"YD Sharma [YD Sharma, 1961, *Summaries of papers, International Conference of Asian Archaeology*] has discovered ochre-coloured ware at Bahadarabad (near Hardwar) which is a Copper Hoard site. RC Sharma and OP Tandon [Quoted by SP Gupta, pp. 1-7] have also found similar types in the ochre-coloured ware at Manpura and Bhatpura. On the basis of this similarity YD Sharma thinks that it is quite probable that the Harappans evolved new types with their movement (eastwards) and then the 'Copper Hoard' culture may be termed as the last phase of the eastern movement of the decaying Harappan culture…BB Lal (BB Lal, p. 39) has made three propositions: First, the people may be the aboriginals of the Ganga basin belonging to the proto-Australoid group. Secondly, they may be identified as the ancestors of modern Mundas, Santhals etc., living in the hilly tracts of Bihar and Bengal. Thirdly, they may be the Nishadas of the Vedic texts whom the Aryans encountered on their arrival in the Ganga basin. SP Gupta (p. 5) has analysed the views of all these scholars and has surmised that in ancient days Munda speaking people inhabited Bengal, Orissa, Bihar, MP and UP. Amongst some of these Munda speaking people the copper industry originated. Due to the pressure of increasing population and natural search for better land, these people migrated into Yamung Ganga valley. Soon they had to encounter the Indo-Aryans who were proceeding from the West to the doab. They were defeated. Intermingling of people using the Indo-Aryan and Munda languages took place. The group which could not co-exist with the invaders fled and took refuge in the adjoining hilly tracts.

"Vincent Smith dated these tools to c. 2000 BCE. Piggott and YD Sharma keep them between c. 1750 and 1000 BCE. BB Lal assigns them the date of c. 1200 BCE. Gordon suggests c. 800 BCE and HD Sankalia has given c. 1500 BCE as their date. However, on the basis of the stylistic comparison and circumstantial evidence these can be assigned to the post-Harappan period. The chalcolithic culture and Copper Hoard culture existed side by side during the period from circa 1700 BCE to 1000 BCE" (GN Pant, 1978, pp. 48-49).



Spear-heads. Sarthauli. Of the 8 specimens found, 5 are from Sarthauli and one each from Fatehgarh, Manpur and Niorai. These may also be called 'hooked swords' with a stout mid-rib and a small flat tang about 2 inches long. These are between 2.25 to 28 inches long. The projectiojn may have been used to fasten to the shaft.

Anthropomorphic 'all purpose' tools

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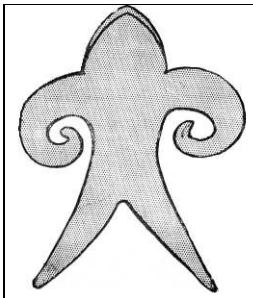
Anthropomorphic figure. Fatehgarh.



Seven anthropomorphic figures have been discovered in Bha_rata: 3 from Bisauli (one exhibited in Municipal Museum, Llahabad; 2.5 in. long and in. wide). , 3 from Fatehgarh and from Sheorajpur. Such types of objects have not been found in any other part of the world. These were perhaps all-purpose tools. Some of these are very heavy, weighing ten pounds or more. The head is blunted, hammered into a flanged ridge; it could have been used to break skull of animals or enemies. It could also have been used as a missile. The curved arms, shaped like the horns of a ram, are sharp and could have been used for cutting. The long and blunt legs could have served as hand-grips or handles of the tool.

S.R. Rao notes: "The fact that bar-celts and chisels and flat rectangular axes (celts) were as popular in the Copper Hoard and the Indus Valley Cultures should not be overlooked. By 1900 B.C. the Harappans had already evolved at Lothal the crescentic sleeved axe which is associated with the Copper Hoard people and resembles the Bisauli anthropomorphic figure (S.R.Rao, 1973, *Lothal and the Indus Civilization*, Bombay, Asia Publishing House, 183-84). Copper Hoard Culture (1100-800 B.C.) is characterized by antennae sword, anthropomorph and the harpon, celts, axe-blades, socked axes and knowledge of closed casting method (similar to the methods of the Harappans).

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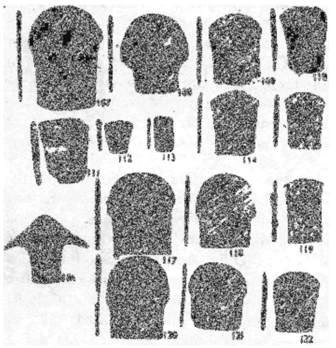
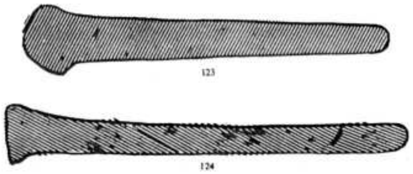
Celts

Flat and shouldered celts. [After Figs. 107 to 122 from GN Pant, 1978, p. 54] 107. Indilapur; 108. Dunria; 109.Bithur; 110. Bithur; 111. Najhanpur; 112. Bithur; 113. Bithur; 114 Indilapur; 115 Pondi; 116. Sarthauli; 117. Dhaka; 118. Bithur; 119. Dhaka; 120. Dhaka; 121. Dhaka; 122. Bithur



Of the 32 copper hoard sites listed by BB Lal (1951), 23 have yielded flat celts The specimen from Poondi (no. 115) has a splayed out cutting edge; 7 inches long, 5 ½ inches wide and weighs 4.5 pounds. Shouldered celts have been found from 17 sites. The specimens from Dhaka (Nos. 117, 119, 120, 121); the blade of one of these celts is 5 inches long and weighs about 4 pounds.



Bar celts from Gungeria. 4 to 6 inches wide; 1 to 2 ft long; bottom is flat, section is rectangular; cutting edge is sharpened. Copper celts imitated those in stone (BB Lal, 1951, p. 32; Pl. XIA; fig. 5,1). The celts of this type have been found at Chanhujo-daro (EJH Mackay, 1943, *Chanhu-daro Excavations*, Pls. LXVIII and LXXI) and at Nal. The Chanhujo-daro specimen is 10 to 13 inches long. These weapons could have been used as cleavers.

Four massive copper objects (total weight: 65 kgs. without any tin alloy, like the Copper Hoards which totally weighed over 400 kgs.) were found at Daimabad: a wheeled chariot with a charioteer and drawn by bullocks; a rhinoceros and a buffalo on four wheels; an elephant (wheels were missing). Daimabad site revealed 5 chalcolithic levels: Savalda culture (Savalda located on the bank of Tapti river), late Harappa culture, Daimabad culture, Malwa culture and Jorwe culture.

S. R. Rao (1979, 1985: Lothal report) noted that Mohenjodaro copper and Rajasthan ore contained arsenic while the copper artefacts of Lothal were remarkably arsenic-free. The possible inferences are: Mohenjodaro artisans used copper obtained from sources other than Rajasthan to add arsenic; Lothal artisans might have used copper imported from Oman; Lothal artisans knew the techniques (evident in later-day Ahar) of roasting copper ore to remove arsenic. “Copper seems to have been purified in the Lothal workshops and exported in the form of bun ingots. One of them found at Lothal is of 99.8% purity and it is arsenic-free unlike the Mohenjodaro ingot.” (Rao, S.R., 1985, *Lothal, A Harappan Port Town, 1955-62*, II, Delhi). Not one of the 300 copper objects found at Lothal contained arsenic.

Mackay (1938:450-453) refers to the occurrence of ‘quite a number of ingots and castings which throw considerable light on the methods adopted by the metallurgists of Mohenjo-daro.’ The ingots were plano-convex, 3.6 in. dia, 1 in. thick. The uneven top indicates that ‘the ore was smelted in an open hearth with charcoal over a cavity in the ground into which the metal ran’. Blade-axes were cast in closed moulds set on edge or on one end.

Metallurgical-workshop-complex at Harappa

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Drawing of Mohenjodaro (Museum of Mohenjodaro); cf. Jansen M., and G. Urban eds. *Reports on Field Work carried out at Mohenjodaro, Interim Reports Vol. 2*, 1987, Fig.7.

Aerial view, DK-1 or Moneer area, Mohenjodaro (ibid., Fig.1, p. 27).

Kalibangan: a floor of a lower town house with decorated tiles

Brick platform at Harappa_, with socket; eighteen such circular platforms were discovered on the banks of the River Ravi (After Fig. 4 in: Mortimer Wheeler, 976, *My archaeological mission to India and Pakistan*, London, Thames and Hudson).

Source:
http://www.harappa.com/indus2/index.html Slide 157_To the south of the "granary" or "great hall" at Harappa is an area with numerous circular working platforms that were built inside small rooms or courtyards. These circular working platforms may have been used for husking grain. One of these circular platforms had what may have been a large wooden mortar placed in the center.

"British archaeologist Sir Mortimer Wheeler excavated a platform in 1946 and concluded it was used for threshing or pounding grain. But HARP's excavation of another example just west of Wheeler's suggests that what he took for the remains of a decayed wooden mortar was, in fact, the remnants of a circular pit or posthole dug through archaeological deposits from half a meter above the platform. We found that both platforms had been enclosed on all four sides by baked-brick walls, although few bricks remained because of subsequent brick robbing — some of it by the ancient Harappans themselves.
"So the question remains: What was going on atop these baked-brick, circular platforms inside enclosed structures? At Harappan sites, platforms of closely fitted bricks laid on edge are usually associated with the use of water. Perhaps these circular platform installations were used to prepare indigo dye, which in South Asia traditionally involved fermentation in a darkened room. Sediment taken from between the bricks and in the center cavity of the HARP platform is being analyzed to test this hypothesis." Source:
http://www.discoveringarchaeology.com/0800toc/8feature1-indus.shtml

Harappa Mound AB in relation to the circular worker's platforms

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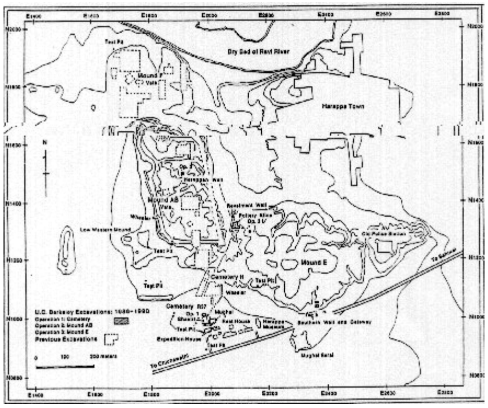
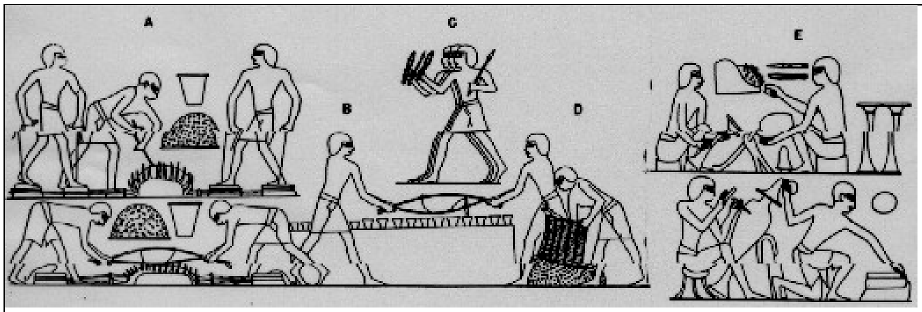
All the 18 platforms are equi-distant from one another, the distance varying between 6.09 to 6.4 m from centre to centre. 'Each platform is 11 feet in diameter and consists of a single course of four continuous concentric rings of brick on edge masonry with a hollow at the centre equal to the length of three bricks. The mortar used in them is mud but the pointing is of gypsum.' (Vats 1940,I: 74). Vats was uncertain of their purpose; burnt wheat and husked barley were found in the hollow of Platform 8 and led to the surmise that they were used for pounding grains witha pestle. This surmise may not be correct. There is an assemblage of fourteen small houses between these platforms and Mound AB. The houses are symmetrically grouped along three east-west lanes intersected by six narrower alleys at right angles. The houses were within an enclosure wall, traces of which still survive. Each of these small (56 X 24 ft) detached houses was accessed through an oblique passage to ensure privacy; each house had two rooms with partially brick-paved floors. Near these houses, at a higher level, were found sixteen pear-shaped furnaces. Their major axis varied from 1.01 m to 1.87 m in length. A crucible for melting copper found in one of these furnaces is suggestive of their purpose. We, therefore, infer that the circular platforms were part of the metallurgical- workshop- complex.



It is likely that the center of the platform held an anvil for the brazier to hammer the metal artifacts. It is thus possible that this socketed platform was used to work on an anvil (as shown in E in the following Egyptian wall paintings).



Wall paintings (ca. 500 BC) of Egyptian metalworking. A. Fires are blown to a glow by wind from bellows worked with the feet and with cords held in the hands. In the lower register metal is melted in a crucible held over the fire between two rods. B. Molten metal poured from crucible in to molds. C. Workmen carrying tongs and blow-pipes. D. Labourer emptying basket of fuel, probably charcoal. E. Vessels are beaten into shape by stones on anvils, polished smooth by small pebbles, and ornamented with incised decoration. The fire in the small furnace was probably used for soldering: Metropolitan Museum of Art (After Fig. at p. 3 in: J. Gordon Parr, 958, *Man, metals and modern magic*, Cleveland, American Society for Metals).

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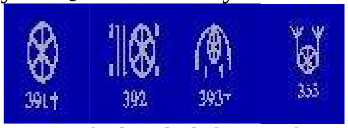
Harappa: reconstructed platform close-up (white colouring is caused by salt seepage) Signs 391-393 and 355 of the script are reminiscent of this circle-shaped platform. Workshop Platforms at Harappa are located both inside houses and in courtyards [**bat.e** = courtyard of a house (Santali.lex.)].



Part of the brick platform on which the original timber (?warehouse) of Mohenjo-daro once stood. The lower figures show how the commodities brought in from the river banks were hauled up on to the main loading platform; the other figure (top left) is crouching in the opening of one of the ventilation ducts.The heavily reinforced platform could have been used to store both ores and metal artefacts as well as fire-wood and charcoal needed for metal-working (cf. Fig. 51 in: Mortimer Wheeler, 1976, *My archaeological mission to India and Pakistan*, London, Thames and Hudson).

The surmise that the circular platform might have been used by a metalsmith is substantiatedat a small, early Harappan site of Padri. (See: Vasant Shinde, Excavations at the Harappan site of Padri (Bhavnagar District, Gujarat) 1990-91 to 1995-96.http://www.picatype.com/dig/dl/dl0aa15.htm#back01)

The village, Padri-Gohil-ni (Lat. 22°22'N; Long. 72°95'E) in Bhavnagar District, Gujarat, is located around 55 km to the south of the District headquarters. The ancient site is 2 km to the south of the present village and is spread over an area of 5 ha with a habitational deposit 3.5 m thick.Remains of 3 cultural periods were found, namely:Period I – Early Harappan (c. 3000 – 2600 B.C.), eriod II – Mature Harappan (c. 2500 – 2000 B.C.) and Period III – Early Historic (200 B.C. – 200 A.D.).

"One of the most significant discoveries is a copper fish-hook, which is 14 cm long and weights 41 gm. A copper fish-hook of such a magnitude has not been reported from any other site so far... The other material equipment include a seal on a stud handle engraved with fish motif, Harappan letters engraved on pot-sherds, cubical chert weights, micro steatite beads, beads of terracotta, carnelian, agate, etc."

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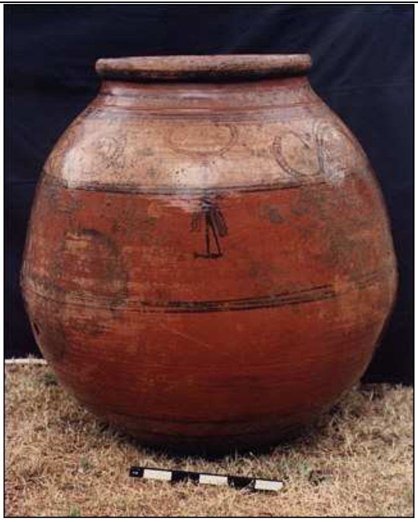

Padri: Storage Jar with painting of a horned head-dress: Mature Harappan Phase (c.2,500-2,000 B.C.) The majestic, curved horns of a buffalo, of the type shown on a seated person on a Mohenjodaro seal are painted on the jar.

Padri: Structure Complex: Rooms including a coppersmith's room with a circular platform,circular furnace and copper implements. Early Harappan Phase (c.3,000-2,600 BCE).

"Early Harappan Phase.It is for the first time that a separate horizon of the Early Harappan has been discovered in Saurashtra consisting of a 60 cm thick deposit at the base of the site. The Early Harappan period has been dated on the basis of C14 determination to between 3000 and 2600 B.C. Two structural phases were noticed in the Early Harappan levels. The first phase is represented by very well made rectangular mud structures. Most structures were residential, possessing cooking and storage facilities. The house of a lapidary was identified and yielded a bead polisher and beads in different stages of manufacture. Large-scale excavation in the subsequent level yielded a large multi-roomed structure complex, ten rooms of which have been exposed so far. Some of the walls of the complex were made of bricks in a size ratio very close to 4:2:1. Some walls were made of sticky black clay and yellow silt. A large part of the complex was used for storage as it yielded a couple of stone-topped mud platforms for supporting storage bins and a number of storage jars of a coarser variety. Some of the rooms were occupied by craftsmen such as coppersmiths and flint-knappers. The room of the former individual yielded a circular furnace, a platform and a number of copper implements. The room of the flint-knapper yielded a small fire-place probably for heating the raw material and a number of waste flakes and finished tools. No evidence of cooking or other domestic activities was found."

The 'imageries' of circular workers' platforms from Harappa and Padri evoke the semantic categories: 'circular' and 'course of bricks'; these may be explained by ancient forms of the following lexemes of the linguistic area, ca. 3000 B.C. (the lexemes also explain the concept of a 'workshop' of a brazier).

Glyph: **bat.i** = a small brass bow (Santali)

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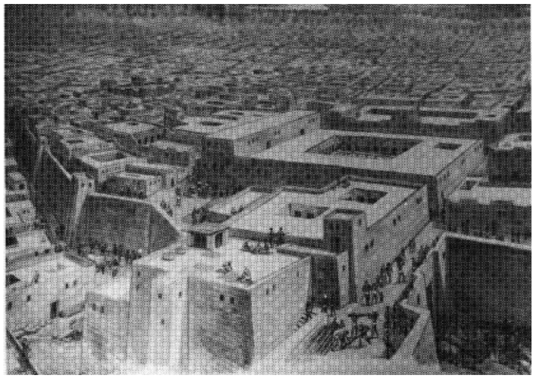
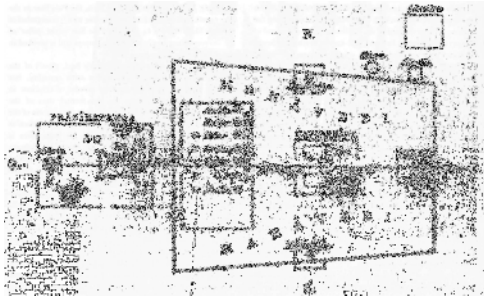
bha_t.i_ furnace (Skt.) pa_tri_ = a small portable furnace (Skt.) pat.t.a a flat orlevel surface of anything (Skt.) **bat.** to trim, make level, straighten (Santali.lex.) vat.t.i, vat.t.ika_ circumference, rim, brim (Pali); varti projecting rim (Skt.); vatti edge, limit (Pkt.); vatti edge of bank or river (Si.)(CDIAL 11360). Image: tire of a wheel: pat.t.e the outer iron rim of a wheel (Ka.)(Ka.lex.) pat.ru tire of a wheel (S.); pat.ru band of iron to tighten anything, tire of a wheel (S.)(CDIAL 7733).



pat.a = course of bricks (Ta.); pat.ukka = to lay stones, build (Ma.)(DEDR 3852) pat.t.at.ai = a layer or course of earthwork, as in raising mud-wall (Ta.);pat.t.ad.a = workshop (Te.)(DEDR 3865) d.a_ = anvil (Te.); at.t.e = a stand, a support (Tu.)(DEDR 86) [cf. cakra-va_t.a = lamp stand (Skt.)] pat.ukkai = anvil; pat.t.at.ai = anvil; smithy, forge; kollan2 pat.t.at.ai = anvil;at.aikal = stone base; anvil;



at.aikur-at.u = anvil; tongs(Cologne Tamil Online Lexicon) [pa_t.aka = a flight of steps leading to the water (Skt.); pat.i =step, stair (Ma.)(DEDR 3850) pat.t.am = tank, pond (Ta.)(DEDR 3856)] va_t.a = m. an enclosure ,(either) a fence , wall , (or) a piece of enclosed ground , garden , park , plantation MBh. Ka1v. &c. (Skt.) va_t.aka site of a house,enclosure (Skt.)

bat.araka = n. pl. circular lines of light which appear before the closed eye AitA_r (Cologne Digital Sanskrit Lexicon) vat.t.am = circle, circular form (Ta.); vartula = n. round , circular , globular BhP. Vet. Hcat. (Skt.)

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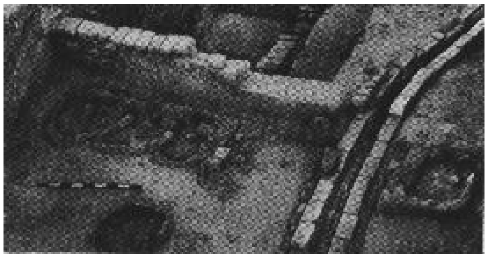
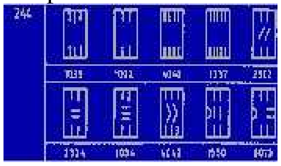
Dhis.n.ya (fireplaces) of the seven sacrificial priests. Vedic Soma Yajn~a. [After W. Caland and V. Henry, 1906-7, *L'Agnis.t.oma: description complete de la forme normale du sacrifice de soma dans le culte vedique*, I-II, Paris: I, pl. 4]

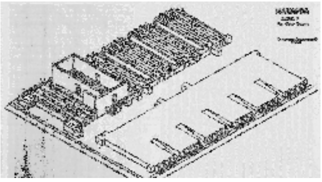


A row of seven(?) 'fire altars', clay-lined pits containing ash, charcoal, the remains of a clay stele (cylindrical and 30-40 cm. high) in the middle; Kalibangan; Thapar 1985: 55.

Kalibangan: well in the courtyard of a lower town house.

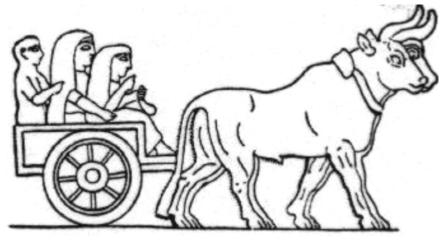
Sign 244 used in script is reminiscent of this building Sign 244 has variants:  Harappa, granary? Warehouse?

An isometric view (After Vats). Between the citadel mound and the old river bank is a series of brick platforms for two rows of six warehouses, each



6m by 6 m (with a combined floor space of about 800 sq. m. To the south of this granary was an area of working floors with rows of circular brick platforms perhaps for threshing grain (wheat and barley chaff were found in the crevices of the floors).

The cultural markers of legacy of the civilization



Assyria, two yoked oxen pulling a cart (G. Contenau, Manuel d'archeologie Orientale, A. Picard, 93, Vol. III, p. 2 5). "Cappadocian texts dating from the end of the third millennium have been discovered to be contacts between large firms and caravan drivers." (Maurice Daumas, opcit, p. 29). Chariot with solid wheels, shown on the Ur standard.

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Ur, Chariot, Photo G. Contenau, from: Maurice Daumas (ed.), *A History of Technology and Invention*, New York, Crown Publishers, 1962, p. 130). The onager or wild donkey is seen on the tablets of Mesopotamia; skeletons of this animal have also been found in the royal tombs at Ur. "The Kingdom of Judea exported copper anr horses; at the beginning of the first millennium BC, King Solomon appears as a great merchant doing business through his port of Ezion-Geber, north of the Red Sea. The American excavations at Megiddo have uncovered the remains of large stables for the temporary housing of the horses. The horse was ridden with a simple saddle blanket, without stirrups; it was used almost exclusively for the war chariot, which was originally a seat on large wheels, and later a box that held from two to four occupants. The wagon, which had either two to four wheels, was sometimes pulled by oxen. The investigations of Lefebvre des Nouettes into harnessing practices in antiquity indicate that for the horse there existed only the neck collar, which strangled the animal when it pulled hard; the absence of the breech band still further diminished the usefulness of the horse as a draft animal. It is possible that the Asian (or so-called Przhevalski's) horse is one of the ancestors of the Assyrian variety." (Maurice Daumas, opcit, pp. 129-131).

Chariot. Italian (c. 550 BCE). Bronze plates on wood. Metropolitan Museum. "Originally chariots were only used in war to bring the warriors quickly and without fatigue to the place of battle. The warrior then dismounted and fought on foot, while the charioteer stayed by to assist in the pursuit if he was victorious or in retreat if he was defeated. Cyrus was the first to change this and make use of the momentum of the weight and speed of the chariot and horses. He invented a

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new sort of chariot with wheels of great strength so as not to be easily broken, and with a long axle to prevent its being overturned. The driver's seat was like a turret of strong timber. Scythes, about three feet long, were attached to each end of the axletree, some horizontal and others pointing toward the ground, evidently to prevent an enemy from seeking safety by falling down and allowing the chariot to pass over him. The horses and driver were clad in complete armour. Somewhat similar chariots continued in use for several centuries. Lighter and smaller chariots were also used." [GC Stone, Fig. 220, p. 176].

Alternative view. Chariot, ca. 550-525 BCE. Etruscan. Bronze, ivory. 51 9/16 in. high. In Mesopotamia the chariot had been preceded by disk-wheeled vehicles with both two and four wheels, pulled by onagers. As noted by Piggott, innovations gave the true chariot its superiority: the spoked wheel; the exclusive use of horse draft (with an adaptation of the yoke for this purpose); the replacement of the old nose-ring control by a proper horse bit; the use of the bow as a primary chariot weapon; and proportions permitting a crew of two to stand abreast.

Solid-wheel, ox-drawn cart. Harappa. (After Shari Clark and Laura Miller/Courtesy Department of Archaeology and Museums, Government of Pakistan).

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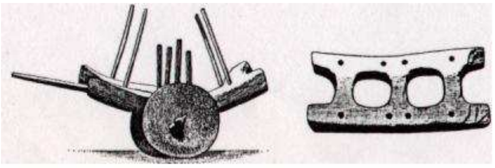
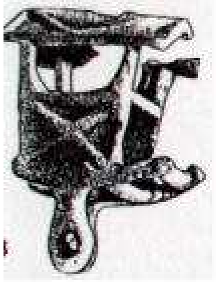
http://bosei.cc.u-tokai.ac.jp/~indus/english/2_2_03.html

Apart from the boats plying on the River Sindhu which are comparable to the boat depicted on a seal of the civilization, the toy cart models unearthed during excavations are not unlike the carts in use even today in Sindh province. Clay model of a cart (pole, posts and axle reconstructed), with a top view of the chassis, Chanhudaro, Sarasvati-Sindhu valley, ca. 2,000 BCE. The axle turns with the solid, non-spoked wheels.



Copper model of a passenger box on a cart, Chanhudaro, ca. 2,000 BCE.

This Chanhudaro passenger box finds a remarkable parallel in the **copper model of a chariot** with four onagers found at Tell Agrab, Mesopotamia (See below: the X-shaped re-inforcement on the box).



"Recent excavations at Banawali in Harayana have brought to light a very good terracotta model of a ploughshare. It consists of a curved beam and a sharp-ended 'shoe' (Bisht, 1987: Pl. 26). More or less similar ploughshares are still in use, not only in Haryana but also in the …neighbouring areas.

"A terracotta model of an axe fitted to a handle found at Mohenjodar (Mackay, 1938, Vol. II, Pl. CXII,1) reminds one of the use of similar axes even nowadays in the countryside for cutting fire-wood for cooking purposes as also for felling trees in the jungle. Similar to what are in use today are fish-hooks found at almost all Harappan sites (for example, Marshall, 1931: Vol. III, Pl. CXLIII, 24-25).

"The usual pattern of an average Harappan house (not of the more than fastidious ones in the big cities) was to have an open courtyard surrounded on three sides with living rooms and having a large frontal entrance into the courtyard through which bullock-carts and cattle could get in. In the courtyard have also been found troughs for keeping fodder and lower parts of large pots for holding water – all meant for the cattle (cf. Lal, 1979: 83-5). Immediately outside the house, flanking the gate, were platforms evidently for people to sit on and chat. The roofs of the rooms were flat, made of wooden beams and

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reed-matting interspersed with earth. Cooking was usually done in the courtyard. This patter of house-plan still persists in the rural areas of Haryana, Punjab etc.

Mohenjo-daro. Terracotta model axe. Mackay, FEM, Pl. CXII,

"Even certain items relating to cooking seem to have survived the millennia. For example, the present-day overground and underground **tandu_rs** in northern Rajasthan, Haryana and Punjab may well be said to go back to the pre-Harappan times. This is duly vouchsafed by the examples encountered at Kalibangan (Lal, 1979, 68-9). The three-legged **pa_ta_** (also called chakala_) used for preparing the bread these days has surprisingly its counterpart in the Harappan milieu. (See, for example, *Indian Archaeology 1958-59—A Review*, Pl. LXVC, for a Harappan specimen from Alamgirpour in Uttar Pradesh). Even the saddle querns and mullers used these days in the villages are not much different from their Harappan ancestors.

"Though the Harappan pottery forms had started changing in the late phases and were no longer to be seen, except for a few examples, in the transformed cultural milieu, yet some forms have strangely survived till today. For example, the **kaman.d.alu** (Mackay, 1938, Vol. II, Pl. LXVI,22,28) and small nozzled vessel used for feeding children with milk (Mackay, 1938, Vol. II, Pl. LXVI,1) have their counterparts even today. (BB Lal, 2000, opcit.)

An exquisite example of bronze sculpture in the civilization is this statue from Mohenjodaro attesting to the competence of the metallurgists of this major trading centre of the Sarasvati-Sindhu doab. The cire perdue technique used to produce this bronze statue is practiced even today by the sthapati-s who produce bronze mu_rti-s in Swa_mimalai
near Kumbakonam. At this place which is celebrated as one of the six sacred pilgrimage sites of Subrahman.ya (Ka_rttikeya ar-upat.ai vi_t.u lit. six army camps) the deity is named E_raka subrahman.ya. The term 'e_raka' is intriguing suggesting it to be a possible cognate with era copper.

Samples of bronze/copper, gold, silver ornaments and beads. (Mohenjo-daro).

Beads and stoneware bowl, Harappa [Discovered in 1996].

More bead samples of the civilization with soldered metal joiners.

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Toiletry and ornaments

'...Harappa yielded an interesting toilet set. It consisted of a pricker, a narrow knife, and a pair of tweezers. The butt of each implement had been hammered out into wire, which was bent back and twisted round the stem to form a loop. The triad of interlaced implements forms an almost exact counterpart to the Sumerian reticules, and show that the idea of the knot-head was familiar on the Indus.

'Elaborate metal plugs made in two pieces were worn in the ears. Strings of spherical, barrel-shaped, tubular and rounded lenticular beads off cornelian, jadeite, ivory, gold, silver, variegated stone, shell, or fayence were hung round the neck or worn as girdles. Multiple necklaces of five strings, separated by spacers, seems to have been specially popular. Some of the barrel-shaped beads are divided into segments by deep cuts. The arms and ankles of the women were encircled with bangles and anklets of gold, silver, fayence, or shell. These ornaments are often of the penannular type, not otherwise represented in the most ancient east, but very popular in Europe during the bronze age.' (Childe, opcit., p. 208).

'The Sumerian and Indus toilet-sets are in principle identical, and each show the same peculiar construction of the looped head. Artistic devices like the use of shell inlays connect the two regions strikingly. Motives like the trefoil and the rosette, even religious themes such as monsters, are common to both countries. It is fantastic to suggest that the wheel and carts had been independently invented in both lands...Were the innovations and discoveries that characterized proto-Sumerian civilization not native developments on Babylonian soil but the results of Indian inspiration? If so, had the Sumerians themselves come from the Indus or at least from some region within its immediate sphere of influence?...A minority from the Indus or saturated with its inspiration might well have been the bringers of wheeled vehicles, toilet-sets, monochrome pottery, mother-of-pearl, and other Sumerian specialities to Southern Babylonia. Yet the Sumerian script is not that of the Indus despite agreements. The Indus art and religion point already as distinctly to historical Indian ideals and cults as do the earliest Sumerian art and iconography foreshadow the classical Babylonian.

''The painted pottery from Harappa and Baluchistan, despite material and significant differences in technique, forms, and decoration, must in the long run belong to the same family as that described as the Prediluvian in Iran. In fact several distinctive motives are common to both groups: the rosette, the dot-ringed circle, concentric semicircles, the step-pattern, the sloping oval, the 'double-axe'. Tell Kaudeni in the Zhob valley very truly links the two provinces with its Indian elephant and its Persian lapis. Were Harappa and Mohenjo Daro offshoots from the prediluvian highland culture like Eridu and al 'Ubaid? Or was the highland culture itself an early branch from the same tree, that, rooted in India, grew into the

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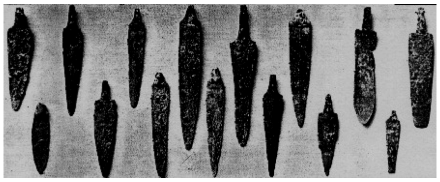
Indus civilization? It would be sheer guess-work to attempt to choose between these alternatives or to decide whether either suffices to explain those similarities between Sindh and Sumer that presuppose racial kinship. Remember that hair was worn in a bun at the back even in the prediluvian village of al 'Ubaid. The second alternative has this to recommend it that it could be harmonized with those hints of an immensely ancient province in the south, rooted in Lower Palaeolithic traditions of industry, where agriculture originated. But with such a speculation we leave at once all hold on the solid world of fact.' (Childe, opcit., pp. 211- 213).

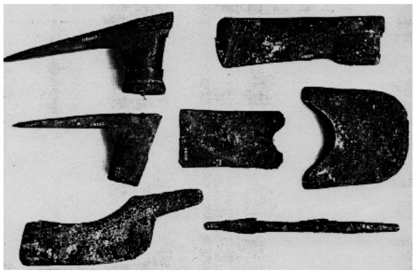
Bull's head from Al'Ubaid, made of copper; ca. 2800 BCE. British Museum. Smelted copper has been found at Al'Ubaid near to Ur, dated to 3400 BCE.

Bronze head of a bull from a wooden lyre found in PG 1332. The head was cast by the lost wax process; the eyes are inset with lapis lazuli and shell (UPM 30-12-696; Ht. 12 cm). The same lost wax process has been used to cast the bronze statuette of a lady with bangles and anklets in Mohenjodaro.

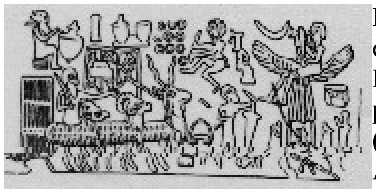


Bronze blade from a ceremonial axe with an openwork representation of an ibex. The blade is dated to the 18th dynasty and is said to be from the eastern delta. New York, Brooklyn Museum.

Dagger blades found at Ur; early dynastic period; British Museum.



Socketed and wedge-headed bronze axes, found at Ur; early dynastic period. British Museum.



Impression of an Akkadian cylinder seal (ca. 2350-2100 BCE) variously interpreted as potting or cheese-making (after Boehmer 1965: no.693). Another interpretation could be that a man is offering a sword to the eagle-person. The three animals following this man could denote some metallurgical objects. The brazier is inscribing a vessel at the top-left.

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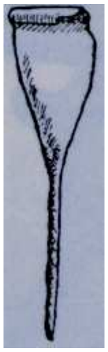
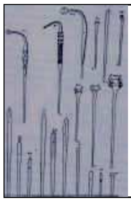


'Part of the commerce between the Indus and the Euphrates was surely conducted by sea as throughout histoic times...Now, throughout historical times the southern coasts of Arabia and especially the region of Oman have been the homes of bold sailors trading with Ethiopia, SIndh and gulf ports. The Arabian Sea is named after them. The author of the *Periplus of the Erythraean Sea* extols their exploits and mentions how the commerce of India and Egypt met in their ports. The Babylonian records from Sargon of Agade onwards make mention of the land of Magan, whence diorite and metals were obtained. [Diorite = a speckled, coarse-grained igneous rock consisting typically of plagioclase, feldspar, and hornblende]. It was inhabited by sea-faring people, and has been plausibly located in Oman. It is perfectly legitimate to infer that such centres of maritime commerce flourished even in the fourth millennium. Only so does the peculiar indirectness of the relations between Sumer and Egypt in Late Predynastic times becomes intelligible. It can hardly be fortuitous that on the later coinage of Arabia appears a distorted version of the twin-serpent motive that constituted one of the links between the Nile and the Euphrates. And Yemen, certainly the source of frankincense, is just as likely as Somaliland to have been the original Land of Punt, that figures so priminently in the oldest Egyptian traditions.' (Childe, opcit., pp. 24-2 5).

'The first investigators of the Elamite and the Indus scripts were alike struck with the resemblance of many signs to the Minoan. Such a similarity would be intelligible if the respective scripts went back to a common system in use among early nautical merchants. The Phoenicians preserved to the time of Herodotus a tradition that they had come from the Persian Gulf-- a tradition quite as worthy of credence as that referring to the foundation of Melqart's sanctuary that excavation has partially verified. It is thus quite possible that the sudden rise of a brilliant maritime civilization on the Mediterranean was due in part to the transplantation across the Isthmus of Suez of some of the coastal culture of the Arabian Sea... The cities of Babylonia throughout history have owed their prosperity to their position at junctions of the great overland routes to India and Inner Asia on the one hand, and to Syria and the Mediterranean on the other, with the maritime route to India and Abyssinia...

'...it looks as if some catastrophe overtook the cities of the Indus basin shortly after 3000 BCE. Mohenjo Daro was deserted about that time, Harappa even earlier. Hence Sumer lost her civilized partner in the commerce of the East.' (Childe, opcit., pp. 216-217).



Raquet pin, Ur. [V. Gordon Childe, 929, *The Most Ancient East: the oriental prelude to European prehistory*, London, Kegan Paul, Trench, Trubner and Co. Ltd., Fig. 82]. 'The hairpin with raquet-shaped heas dhown is another type that recurs in Central Europe; Woolley is no doubt right in suggesting that the tube formed by rolling over the head was designed to support two feathers.' (Childe, opcit., pp. 89- 90).

'Pins fastened the garments or adorned the hair. Favourite types are the bead-headed variety attributed also to the Second Prediluvian culture and the toggle-pin in which the shaft is flattened round the eyelet, and at Kish sometimes decorated with an engraved pattern that recurs on pins of the same family in Central Europe. (Fig. 81,3). Less common are the pins with a stylized bull's head, represented at Kish, while one surmounted by an ape from Ur is unique' (Childe, opcit., p. 189).

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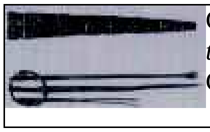
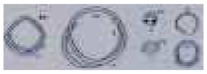

Gold toilet set and case, Ur (U. 9340; [V. Gordon Childe, 929, *The Most Ancient East: the oriental prelude to European prehistory*, London, Kegan Paul, Trench, Trubner and Co. Ltd., Plate XIX b.]

'For the toilet the Sumerians were indeed well provided. The facial hair was removed with razors, flat oval blades with a short tang... 'Cutters', narrow copper strips with an edge at one end and turned over or rounded at the other, seemed to have served a similar purpose, and tweezers were also in use. The latter were combined with prickers and earscoops in regular reticules. The three instruments were attached to a ring and enclosed in a case. The looped head of each instrument, through which the common ring passes, has been formed by hammering out the upper end of the implement into wire and then twisting this wire back upon itself and coiling it round the shaft -- in a word, on the principle of the knot-headed pin.' (Childe, opcit., p. 188-189).

'The arms were decked with bracelets and the fingers with rings, but these ornaments were always of the simplest type. The ear-rings, necklaces, diadems, and pendants illustrate better than anything else the supreme skill of the Sumerian goldsmiths and so give a welcome indication of the level of civilization attained.' (Childe, opcit., p. 190).


Copper bracelets and ear-rings with flattened ends, Kish A, Fig. 83].

Jewellery from graves at Ur [V. Gordon Childe, 1929, *The Most Ancient East: the oriental prelude to European prehistory*, London, Kegan Paul, Trench, Trubner and Co. Ltd.,Plate XXII a,b,c]. 'In the ears were hung helical rings the ends of which have generally been flattened out to a boat-form (Plate XXII). The execution of these little coils and their mounting attests the consummate skill of the goldsmith. No less admirable are the amulets in the form of bulls, some represented as wearing a false beard, birds pecking at fruit, sheep, deer, fishes, and other animals. Lapis, cornelian, gold and silver and fayence (the latter substance not in the oldest cemeteries at Ur) were the commonest material for beads, though shell and various less valuable stones were used. Discs, cylinders, long bicones, barrels and tabular or biconical faceted beads are the commonest types, but there are multitubular and other spacers, gadrooned globes and barrels (at Kish as in Protodynastic Egypt) and compounds -- for instance two axially gadrooned globulars united by a segmented tube. The splendour of the head-dresses of the queen and harem beauties from the older tombs at Ur baffles description.' (Childe, opcit., pp. 190-191).

Earrings and pendants from graves at Ur. [V. Gordon Childe, 1929, *The Most Ancient East: the oriental prelude to European prehistory*, London, Kegan Paul, Trench, Trubner and Co. Ltd., Pl. XXI b].

Processing of minerals

Chalcolithic (Copper-Stone) Age, used pure copper (along with its predecessor tool-making material, stone). Use of copper was known in eastern Anatolia ca. 6000 B.C. and by the mid- 4th millennium, a rapidly developing copper metallurgy, with cast tools and weapons led to urbanization in Mesopotamia.

Bronze Age of proto-historic times is a cultural revolution perhaps second in importance only to the Industrial Revolution of modern times.

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"The fabrication of bronze represented man's first industrial revolution centering in the use of fire...Stannite on smelting yields a natural bronze. This generally steel-gray to grayish-black ore frequently has the appearance of bronze and indeed is called 'bell metal' ore. Stannite fits with the hypothesis that metallurgy was born in a polymetallic setting, where interfluxing and interalloying of ores could occur. This would most generally be a gossan cap on a copper deposit, also containing arsenopyrites and lead-silver...In Egypt in 1976, we relived the experience of predynastic prospectors for gold: of finding cassiterite in the decayed quartzes or greisens, extensions of the gold ones. It was especially rewarding to follow the trail of the bright black placer crystals up the riffles in the wadis. There can now be little question in our minds that cassiterite (SnO_2) was the ore that led toward the identification of tin and the ultimate naming of the metal as *ana_ku* in Akkadian. Stannite could not have performed this function...The several hundred translated tablets from Kultepe and Mari containing references to trade in *ana_ku* from the east, suggesting an origin for tin in Elam or Iran. After a long debate over the logogram *ana_ku*, it seemed that the trade item must concern tin rather than lead or exotic glazes. The reference of the geographer Strabo to tin in Drangiana, or Seistan, which tin had been exhausted." (Theodore A. Wertime, The search for ancient tin: the geographic and historic boundaries, in: Alan D. Franklin, Jacqueline S. Olin and Theodore A. Wertime, eds., 1977, *The Search for Ancient Tin*, Washington D.C., US Government Printing Office; See Theodore W. Wertime, In search of Ana_ku, bronze-age mystery, *Mid-East* 8, May-June 1968, pp. 10-20; J.D. Muhly, Tin trade routes of the bronze age, *American Scientist* 61, July-August 1973, pp. 403-13).

The mineral Cassiterite (SnO_2) or tinstone is usually deep brown to black in colour, but is sometimes red (ruby tin), yellow (rosin tin), and may even be colourless. Heating the tin oxide in charcoal fire or furnace yields metallic tin. The metal melts at the low temperature of 232 C, but the ore requires a smelting temperature of about 100 C. Tinstone is found in the same alluvial gravel deposits as gold; it is probable that when was being sought, the tinstone would have been noticed and the alluvial ore discovered thus.

"In the Late Bronze Age the alloy normally contained 10% Sn, but lead was introduced into castings...tin is found mainly as the mineral cassiterite (SnO_2) which is white in the pure state, but is more often contaminated with greater or lesser amounts of iron which render it brown or black...(Bronzes at Mohenjodaro--2500-2000 BC) cover a range of 3 to 26.9% Sn and it would seem that tin was sometimes available in the 500 years of occupation on this site. At Mundigak, in Afghanistan, only one out of a total of five shaft-hole axes analysed contained as much as 5% Sn...The Early Bronze Age seems to have lasted to about 300 BCE in the Ganges Basin and the Deccan. In the former, Harappa-type cultures have produced a few bronzes containing 3.8 to 13.3%Sn. A site at Jorwe in the Deccan, dated to before 300 BC, produced six very simple flat axes or rectangular form and one copper bangle...Considering that India is near the well known tin deposits of Burma and Malaya, one would not be surprised to see a difference in the use of tin there, and particularly in the quantity used in the Early Bronze Age, compared with the use made of it in places not so close to known tin deposits...It is generally accepted that the Iron Age started in Asia Minor where iron using people have occupied the area from about 2000 BCE. During the Bronze Age copper ores would have been smelted with the aid of iron fluxes, and there would be a distinct possibility of iron being reduced in the bottom of the furnace." (R.F. Tylecote, 1976, *A History of Metallurgy*, London, The Metals Society).

The pin at Tepe Hissar 1 (ca. 3900-2900 BC) had 1.74% Sn; dagge at Geoy Tepe (ca. 2000 BC) had 0.5% Sn; dagger at Tepe Yahya (ca. 3000 BC) had 3.0% Sn; the blade and pin at Ur (ca. 2800-2500BC) had 2.4 and 1.0% Sn respectively; the fragment at Mohenjodaro (ca. 2100-1700 BC) had 1.2% Sn; dagger at Tel Asmar (ca. 2500 BC) had 2.63%Sn. There are indications that bronze was being made by 'cementing' copper with tin oxide in the Late Bronze Age. At Tepe Hissar (ca. 2100-1800 BC), only alloys containing 0.78% to 2.24%Sn were found. At Susa, alloys did not exceed

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1.63% tin content even as late as 1800 BCE. However, the 'Luristan Bronzes' (1500-700 BC) show the true flowering of the Bronze Age in Iran. In Crete, dilute bronzes (3.14, 3.16% Sn) appear only during the Middle Minoan I (2000 BC). Cretan Minoan double axes are mostly tin bronze (3 to 18%Sn). Moulds for these objects were found at Malli and on Melos.Evidence for trade in tin or cassiterite comes from the wreck found off the coast of Cape Gelidonia in southern Turkey; this find is dated to the Late Bronze Age (1200 BC). About 16 kg of white material containing 14% SnO_2 and 71% $CaCO_3$ were recovered from the sea bed. This may represent corroded material from a tin ingot having a cross-section of about 6 cm sq. The cargo included copper and bronze ingots and scrap metal. The ship was travelling in a westerly direction and the suggestion is that it was a Syrian ship taking copper from Cyprus to the Mycenaen civilizations in Crete or Greece. This tin was certainly not obtained in Cyprus and should have been traded from more distant places and picked up at one of the ports of call. (Tylecote, opcit., p.15).

Susa, Tepe Yahya, Sahr-i-Soktha

"...(Sumerians of the Late Uruk period) established a colony on the acropolis of Susa (biblical Shushan, modern Shush), where the southern Iranian trade route to northwestern India began. Its original purpose was to obtain carnelian, the only ancient source of which was the Gujarat Peninsula. The presence of Uruk pottery at Yahya Tepe, the most important caravan city on that road, reveals that city's links with Susa. After about 3000 the so-called Proto-Elamites took over Susa, Godin Tepe, and other sites in Iran...One of the sites, Shahr-i-Sokhte, was located near an important area of tin deposits. With the start of the Bronze Age, tin became a major object of international trade, and Elam controlled its supply for a long time afterward... a long-lasting connection by land and sea was established between lower Mesopotamia and the Indus basin (which the Sumerians and Akkadians called Melukkha)." (Michael C. Astour, 1995, Overland trade routes in ancient Western Asia, in: Jack M. Sasson (ed.), *Civilizations of the Ancient Near East*, Vol. I, pp. 1401-1420).

Lead, tin, silver and gold

"In the ancient Near East... when working gold by streaming, nodules of cassiterite (or tin-stone SnO_2) were found. This cassiterite was reduced by workers already proficient in the production of gold, silver and lead. The metal obtained was held to be a kind of lead. [In Sanskrit, the term for lead is: **na_ga**. In Akkadian, the term for tin is: **anakku**). Lead and antimony were already used to increase the ease with which copper could be cast, but neither of them improved in its other qualities, notably the tensile strength. From trials with the new kind of 'lead', it would be learnt that this mixture was now improved in tensile strength as well as in ease of casting. Nor was it necessary to produce this new metal first; unrefined copper had only to be smelted with charcoal and stream-tin to produce a new kind of 'copper' (ayas in Rigveda), namely bronze, with superior qualities for tools and weapons. At the same time, certain naturally mixed ores were also worked, and were found to give the better kind of 'copper' directly. We have no proof that the tin compound of these mixed ores was ever isolated or recognized. Furthermore, at this early stage the tin content of the bronze could not be adequately controlled, and therefore varied between fairly wide limits." (Adapted from: R.J.Forbes, 1954, Extracting, smelting and alloying, in: Charles Singer, E.J.Holmyard and AR Hall (eds.), 1954, *A History of Technology*, Oxford, Clarendon Press).

***Na_ga*, lead ore**

An early bead necklace found buried with a young woman in Level VIA at Catal Huyuk in Turkey (ca. 6000 BCE) was made of galena mineral (lead sulfide).

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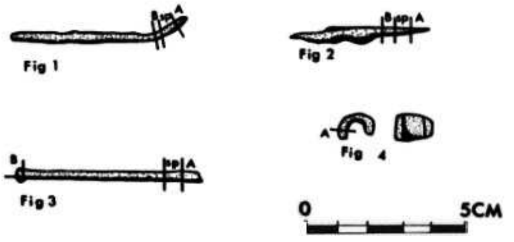
"The best evidence for the existence of a smelting technology comes with the use of lead, not copper. Native lead is extremely rare, so it is most likely that any ancient land artifact was made of lead smelted from various lead ores, including galena (lead sulfide), the most common lead ore and one that occasionally contained silver, This silver was extracted from the lead by a process known as cupellation. It is commonly argued that all metallic lead found in Bronze Age or earlier contexts was produced as the inevitable by-product of the recovery of silver. This cannot be correct, for many early lead artifacts contain too much trace-element silver for their lead ever to have been desilvered. The earliest known lead artifacts also come from a time that must predate the first use of the cupellation process. It has to be accepted that, in the Bronze Age and earlier, lead ores were being smelted in order to obtain metallic lead." (James D. Muhly, 1995, Mining and Metalwork in Ancient Western Asia, in: Jack M. Sasson, ed. 1995, *Civilizations of the Ancient Near East*, Vol. III, New York, Charles Scribner's Sons, pp. 1501-1521).[4]

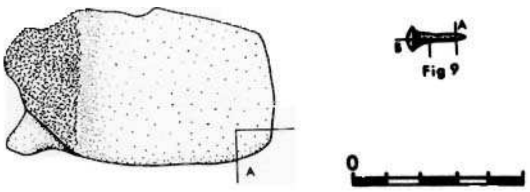
By 3000 BCE the use of copper was well known in the Middle East, had extended westward into the Mediterranean area, and was beginning to infiltrate the Neolithic cultures of Europe .

Copper objects

Tepe Yahya XC 3, 1973 is a small period VI (4,500-4,000 BCE) copper and 5.6 cm. In length X a maximum of .3 cm in width; the deformation visible in cross section indicates extensive hammering.



T. Yahya C-7-15, 1969 (fig. 8.2) is a pin, circular in cross section with a sharp and slightly deformed point. The section of the point area is deformed by cold hammering.
The knob-headed pin, XC 8b-40 (fig. 8.3), circular in cross section
T. Yhya C 115-3 1970 (fig. 8.4) is a copper bead fragment 1.1 cm in width totally corroded with malachite and cuperite layers.



Tepe Yahya flat ax, XC tt1-7 1970 (fig. 8.8) appears to have been cast into single-piece rod. It is 7.7 cm in length X 3.5 cm in width X .1 cm thick. The blade edge is wide and has rounded corners. Period VA (3500-3200 BCE). Copper nail, XC tt-2-2-5 1971 (fig. 8.9) is 1.6 cm in length X 1 cm in dia at the head X .05 cm in dia at the point. This nail, cast into shape and slightly retouched by hammering and annealing, was slowly cooled after the last anneal. All the metallurgical techniques used for the succeeding 2000 years were introduced at Tepe Yahya during this period. '…appearance of weathered native copper and copper-arsenides suggests the use of copper-arsenide minerals along with native copper. Native copper, which had been hammered, is documented in 5th and 4th millennia Iran. The use of copper-arsenic alloys during the first introduction of true metallurgy has also been documented here. The rapid spread of copper-arsenic mineral utilization throughout Iran attests to the success of the alloy, to experimentation and observation by the ancient smiths, and to the communication network of technological ideas/concepts of early 4th millennium Iran…Tin bronze…was present at Tepe Yahya only in 3rd millennium contexts and then in very limited quantities…Tin bronze was extensively used in the

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contemporary Indus Valley civilization and in the preceding Nal Cemetery and Mundigak III contexts. The presence in period IVA at Tepe Yahya of an Indus seal impression and two etched carnelian beads is suggestive…The metal objects comprised both tools and ornaments, with tools predominant.' (pp. 259-261).

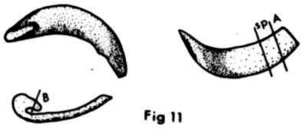

Fig 11

Copper bracelet with a hook, XBE tt1-10 1973 (fig. 8.11) is roughly rectangular in cross section.More than 20 metal objects (pins – some elaborately decorated--, bracelets, decorative items, spatulas, nails and beads) were recovered from the context of Period IV C (3200-2900 BCE) which also saw the use of copper arsenic alloying.

Knife blade fragment, XBE tt1-2 1973 (fig. 8.23), measures 4 cm. In length and 7 cm. In maximum width; transverse section through the blade reveals a rounded blade edge. The blade was cast and then cold worked and annealed, was worked after the final anneal.

Fig 23

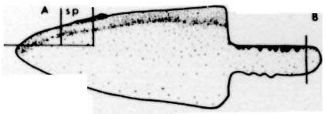

Fig 24

Large well-made projectile point, B-BW tt2-12 1970 (fig. 8.24) has a beveled blade edge and incised tang. There is also a slight midrib. IT is 10 cm. Long X 3.7 cm. In maximum width at the blade-tang junction. The incised decoration on the tang was cast with a piece and then grooves were chiseled out. Period IVA (2400-1800 BCE) saww the presence of two etched carnelian beads, a stamp-sealing on a sherd of Harappan script, and a Harappan terra-cotta cake with a stamp seal of a dancing cross-legged man. This latter material is the only evidence on the Iranian plateau which indicates contact and contemporaneity with the Sarasvati-Sindhu Civilization.

[Dennis Heskel and Carl Clifford Lamberg-Karlovsky, 1980, An Alternative sequence for development of metallurgy: Tepe Yahya, Iran, in: Theodore A. Wertime and James D. Muhly (eds.), *The coming of the age of iron*, New Haven, Yale University Press, pp. 229-265]

It wasn't until approximately 3800 B.C. that bronze was produced in Tepe Yahya, Iran from the accidental blending of copper with other metals. This new mixture exhibited better properties than copper alone. Metal workers quickly found that bronze was more durable and easier to cast than copper. They found it could be bent and reworked back into its original cast shape.

The most important development in the making of bronze was the evolution of the tin-copper alloys. Depending on the tin content, these bronzes provide a wide range of valuable properties, such as hardness, toughness, or ease of casting. To make them requires a deliberate addition of tin to the copper metal. To make a significantly valuable tin-bronze, about five percent of tin is required-more if various specific properties are desired. The tin can be introduced into the copper in several ways. The simlest method is by "cementation," i.e., adding tin ore of reasonably high grade to molten copper along with charcoal. The most controllable method is to add the tin as metal to the copper.

Tin is not widely distributed and is really a semiprecious metal. Tin hardly ever occurs "native" as metal. Its only really significant ore is cassiterite (SnO_2), which is normally a dull drab brown material that is difficult to distinguish from ordinary rock unless sensitive methods are used. Cassiterite has two specific properties that are useful for its separation and identification. It is very dense and if crystals of the ore are present it can have a bright sparkle because of its high refractive

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index. Occasionally a lump of cassiterite is found in a lode, but this is not at all common. Rich ore holds about 5.0% metal, good ore about 2.0%, and skilled miners in western England work down to about 0.2% from stream detrital deposits. Tin also occurs in the mineral stannite ($Cu2SnFeS4$), but this is quite rare and is not considered an important ore. Tin ore is virtually always found associated in some way with an "acid"-high silica content-rock. The density of cassiterite ranges from ca. 6.99 to 7.0 g/cc, gold from 12.0 to 20.0 g/cc, and hematite (an iron ore [Fe203] that is found associated with the Turkish tin ore) 5.26 g/cc. The typical waste-gangue-minerals with this ore are quartz, 2.65 g/cc, and calcite, 2.71 g/cc. These densities indicate the relative ease of separation by a "washing" process. There are considerable similarities in the initial stages of the mining and dressing (concentrating) of tin and gold. Similar to gold, cassiterite is usually found entrapped in gangue mineral if it is in the original lode containing the ore. A lode occurs like the cheese in a sandwich, where the cheese is the orestuff and the bread on either side the surrounding country rock. The lodestuff has to undergo several treatments. To be worked it must first be mined out, crushed to release the valuable material, and then dressed, usually by using moving water to displace the lighter gangue minerals leaving a rich head of the heavy particles of cassiterite or gold.

If the tin-gold ores have been broken down out of the lodes by weathering, the material is often carried to a stream along with the gangue, usually in gravel or sand-like debris. Often the ores can be obtained by washing, but in some cases crushing is needed to release them.

The washing can be done in a number of ways. Using a pan or similar vessel such as conical bowl-a batea-is one method, or the orestuff can be thrown into running water flowing in some form of trough or inclined plane, often with a prepared surface so that the heavy ore particles settle out of the water apart from the waste. In very dry districts winnowing can be used to make an initial separation.

A much used assay for cassiterite developed in western England's metalliferous region: a powdered sample of orestuff is swirled with water on the blade of a shovel and then given a series of upward flicking motions. The heavy cassiterite is tossed up through the water and appears as a crescent shaped patch at the top of the charge with the lighter waste below. The size of the cassiterite head indicates the richness of the ore. This technique, known as "vanning," was still in use at a major tin mine until 1985. It was a highly practical assay. It had the advantage of separating the cassiterite that could actually be recovered by washing techniques. A skilled vanner can detect down to 0.1% cassiterite in the lodestuff. The introduction of the very effective tin flotation dressing method has shown that vanning undervalues the ore.

(Extracts from the article which originally appeared in The Oriental Institute News and Notes, No. 146, Summer 1995, and is made available electronically with the permission of the editor. *Tin Smelting at the Oriental Institute*, By Bryan Earl, Metals Specialist, and K. Aslihan Yener, Assistant Professor, The Oriental Institute and the Department of Near Eastern Languages and Civilizations The University of Chicago)

[The winnowing etc. processes are reminiscent of the Soma processing described in the Rigveda. See lexemes in the link and interpretation of Soma as electrum by Kalyanaraman in his forthcoming book (in press): *Indian Alchemy, Soma in the Veda*, Munshiram Manoharlal, Delhi.]

"In the ancient Near East... when working gold by streaming, nodules of cassiterite (or tin-stone $SnO2$) were found. This cassiterite was reduced by workers already proficient in the production of gold, silver and lead. The metal obtained was held to be a kind of lead. [In Sanskrit, the term for lead is: na_ga. In

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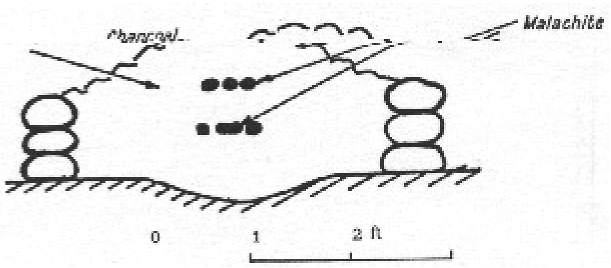
Akkadian, the term for tin is: anakku). Lead and antimony were already used to increase the ease with which copper could be cast, but neither of them improved in its other qualities, notably the tensile strength. From trials with the new kind of 'lead', it would be learnt that this mixture was now improved in tensile strength as well as in ease of casting. Nor was it necessary to produce this new metal first; unrefined copper had only to be smelted with charcoal and stream-tin to produce a new kind of 'copper' (ayas in Rigveda), namely bronze, with superior qualities for tools and weapons. At the same time, certain naturally mixed ores were also worked, and were found to give the better kind of 'copper' directly. We have no proof that the tin compound of these mixed ores was ever isolated or recognized. Furthermore, at this early stage the tin content of the bronze could not be adequately controlled, and therefore varied between fairly wide limits." (Adapted from: R.J.Forbes, 1954, Extracting, smelting and alloying, in: Charles Singer, E.J.Holmyard and AR Hall (eds.), 1954, *A History of Technology*, Oxford, Clarendon Press).

Arsenic alloying preceded tin alloying in West Asia. Tin alloys started in Iran only during the third millennium B.C. Lollingite (FeAs2) samples were found in Nal (Southern Baluchistan). It is likely that arsenic might have been used both as hardener of copper and as a deoxidiser. Lead was used as a flux. Tin has always been found as an alloy with copper in almost all the sites of the civilization during the mature-Harappan phase. The percentage of tin in bronze averages from 6 to 13 percent (MIC, I, 30).

Words for Copper

Open fire as an experimental copper-smelting hearth. Tylecote, 1962, p.26. Charcoal will burn to carbon monoxide and malachite will be reduced. Roasting and melting process may have to be repeated until practically pure cuprous sulphide is obtained from copper pyrites, a mixed sulphide of copper and iron. The 'matte', that is, the copper sulphide, when sufficiently freed from iron, may be dead roasted; converted into the oxide and then reduced to the metal with charcoal.(After Fig. 1 in H.H. Coghlan, 1975, *Notes on the prehistoric metallurgy of copper and bronze in the old world*, Oxford, OUP).



"...the studies which have appeared on the subject of Bronze Age trade have been severely limited in scope, both chronologically and geographically. They have been written principally by archaeologists, as philologists have shown a remarkable lack of interest in fields beyond grammar and lexicography, and they have been based upon the evidence beloved by all archaeologists, the typology and distribution of pots, figurines and metal implements. and weapons. The historian finds himself in a peculiar and precarious position. Being neither archaeologist nor philologist, he must still attempt in some way to master and utilize the data from both disciplines and to create from this data a meaningful historical synthesis which does justice both to the texts and to the pots...

"The basic ores of copper are classified as either oxide, carbonate, or sulphide. In brief, the principal ore minerals are oxide ores: cuprite (red oxide), melaconite; carbonate ores: malachite (green basic carbonate), azurite (blue basic carbonate); sulphide ores: chalconite (copper glance), covellite. There are also sulphide ores containing large amounts of iron, the main minerals being chalcopyrites (copper pyrites), bornite (peacock ore)...Technically, the sulphide ore must first be roasted in an oxidizing atmosphere, in order to produce a copper oxide. Then the copper oxide reacts with the copper sulphide to produce copper and sulphur dioxide. If the initial process is incomplete, thus producing a material known as *matte*, an impure mixture of copper and copper sulphide, this *matte* must be fully roasted to oxide and

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reduced with carbon, like a simple oxide ore, to produce pure copper...it is now clear that sulphide ores were already being utilized by the fifth millennium BCE. They were used without any real change in the technique of refining the ore and the result was a copper contaminated with sulphur. Such crude copper or <u>matte</u> seems to be the 'black copper' referred to in Old Assyrian and Greek texts. [Note: It is likely that the reference to kr.s.n.a_yasa in Vedic texts may also refer to *matte*]. This means that the very earliest coppers will be the purest coppers, being either native copper or copper smelted from oxide and carbonate ores. (s'ya_ma_yasa)...

"Etymology has often been used to determine the origin of the metals used by a particular group of people, and even the origin of the peoples themselves. Unfortunately, such studies have only too often been based upon questionable philology and have proceeded with a total disregard for archaeological and historical considerations. They have been dominated by theories of substrate and proto-languages and by a common tendency to attribute consequences of major significance to the widespread migration of obscure peoples. The English word *copper* belongs to the same language family as German *Kupfer,* French *cuivre,* Swedish *koppar*, and Danish *Kobber* as well as many other words, all deriving from Latin *cuprum*...The original form is *cyprius,* an absolute form of the adjective *cyprius, -a, -um,* "of or pertaining to Cyprus." The form *cuprum* is an artificial formation in *-um,* based upon othe rmetal names in Latin, such as *aurum*, "gold", *argentum,* "silver", and *ferrum*, "iron"...The true explanation is not quite so simple...The common Greek word for copper is □□□□□ṣwhich now appears as *ka-ko* in the Myceneaean Linear B tablets. Also, the common Latin word for coper is not *cuprum*, but *aes, aeris*...It was only in the Roman period that the island (Cyprus) became famous for its copper mines. At that time there developed the expression *aes cyprium*, "Cyprian copper," which is found in Pliny. By ellipsis the expression *aes cyprium* becomes first *cyprium* and then *cuprum,* meaning simply "copper". [Note: these elaborations apply equally to the Vedic word: *ayas*, copper]...the word □□□□□s may be a name for metals in general, rather than for any specific metal. This is suggested both by a possible connection with Proto Indo-European **ghel (?)gh-*, "Metallbezeichnung," and by the use of the world itself in Greek texts. Greek does not distinguish between copper and bronze, using □□□□□s for both, but it does seem that □□□□□s originally designated copper and arguments based upon the precise meaning "bronze" are open to question. Latin *aes,* and such related words as Gothic *aiz,* go back to a reconstructed Proto Indo-European **ajos*, which again designates "copper," "bronze," and "metal" in general. The related Sanskrit form *ayah*, also designates 'metal' and seems to represent 'iron' in particular [Note: an erroneous reconstruction by Mayrhofer]. (Mayrhofer, M., *Kurzgefasstes etymologisches Worterbuch des Altindischen,* I, Heidelberg, 1953, p.46). The word **ajos* has played a major role in various arguments relating to the question of the original homeland of the Indo-European peoples. It is supposed to represent one of those elements such as the beech tree, the salmon, and the turtle, present in the original homeland. (A. Nehring, in *Die Indogermanen und Germanenfrage, Neue H'ege zu ihrer Losung,* Salzburg, Leipzig, 1936; A. Scherer, *Kratylos,* X (1965), 1-24). **Ajos* has been compared with *i_sarnon*, the Celtic word for iron, but this is probably false. (E. Benveniste, *Celtica,* III (1956) 279-283. Benveniste argues that **i_sarno-* means 'the divine (metal)' and that the word is related to *aisar*, the Etruscan word for god)...(For a list of the words for copper in the modern Indo-European languages see J.R. Marechal, *Ogam,* XVIII (1966), 203-211, p. 209). In the effort to establish a background for **ajos* it was suggested that it must be related to the name *Alas'iya,* thought to be the name of the island of Cyrpus in the second millennium BCE. Both *Kypros* and its predecessor *Alas'iya* were assumed to mean the 'Copper Island'. (see G. Dossin, *Academie Royale des Sciences des Lettres et des Beaux Arts de Belgique, Classe des lettres et des sciences morales et politiques, Bulletin,* 5 Serie, XXXV (1949) 310-315)....As already pointed out above, the foundation of the argument is false, as *Kypros* has nothing to do with copper. The superstructure is equally false. It is now recognized that Egyptian **-es-ja (*or *'i-s-y)* as, *Ajasja* is now transcribed, and *'a-la-s'a* (or 'i-r-s') *Alas'iya,* represented two distinct countries, and that neither one has any connection with copper. (A. Nehring, opcit., p.30)...The Proto Indo-European **ajos* seems to go back to a period when it was not necessary to distinguish between the various base metals. As copper was the first basic metal, **ajos* must originally have stood for 'copper'. Then, as first bronze,

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and finally iron became the predominant metal, the meaning of **ajos* and its derivatives, was expanded to include these new materials...

"The Hittite word for copper is *ku(wa)nnan-*. [J. Friedrich, Hethitisches Worterbuch, Heidelberg, 1952, p. 122, s.v. *kuuanna(n)*]. It designates objects made of copper, alternating with Sumerian URUDU, and also appears in lists which combine metals and precious stones. But *ku(wa)nnan-* also appears with the determinative for stone (Sumerian NA4) and clearly designates a substance from which beads are made, beads which are even engraved. This suggests a comparison with Greek *kyanos*, a dark blue glass-paste used as a substitute for lapis lazuli...Are *ku(wa)nnan-*, 'copper', and *ku(wa)nnan-*, 'blue glass-paste' accidental homonyms or are they somehow related? It may be that the common factor here is the blue color. This could mean that the Hittites first obtained their copper from the blue basic carbonate ore called azurite and also that the Hittite scribes recognized that such copper salts contributed the blue color to the glass-paste mixture...The Hittite word for bronze is *haras'u-*, a word of unknown derivation...

"The Sumerian and Akkadian cuneiform texts provide extensive evidence for the distinction between copper and bronze, but the words involved give no indication of the source of the metals in question. The Sumerian URUDU (better URUD), 'copper', is said to be derived from an original *BURUDA, which is supposed to mean 'mine'. However, there is no evidence to support such an etymology...The Akkadian *eru (<werium)*, 'copper', has been compared with *ma_t H'arium*, known as an early Old Babylonian name for the kingdom whose capital was at Es'nunna...As for *eru*, it has been associated with Eridu, the name of the oldest Sumerian city. None of these proposals can be taken seriously...Nothing more is known about the words for bronze. Sumerian *zabar* (<*sipar*), Akkadian *siparrum*, could perhaps be related to the name of the city of Sippar...Finally, it should be pointed out that a lack of distinction between copper and bronze is characteristic of the Indo-European languages, while all the languages of the Ancient Near East make a distinction between the metal and its alloy. This suggests that bronze developed early, and first became imortant, in the Ancient Near East...In Europe, bronze was rather a late-comer and was not known to the early inhabitants. This is also the reconstruction suggested by the archaeologicla evidence...

Coppper from Meluhha

"The lexical series HAR-ra-hubullu contains the following section:

urudu Ni.TUKki til ma nu u
urudu NI.TUKki-as nu u
urudu ma-gan-na ma ak ka nu u
urudu me-luh-ha me luh hu u
(The reference to three lands: Tilmun, Magan, and Meluhha, are associated with copper)...

"The main copper deposits in Afghanistan are in the Shah Maksud mountain range. There is also copper in India and in Baluchistan. The major copper deposits seem to be those in the region of Rajasthan, east of the Indus river. Yet the general opinion has long been that metallurgy never really caught the imagination of the craftsmen of the Indus Valley and that the area was never a significant metal working center. This is the interpretation given by Sir Mortimer Wheeler:

Copper seems never whole heartedly to have occupied the genius of the Indus craftsmen; as a relatively costly import, it was used with economy, although, in addition to implements, bowls, cups, and dishes were sometimes made of the material. The ore may have been obtained overland from Rajasthan or from Afghanistan, but supplementary imports by sea may be suspected, and tin was almost certainly introduced in this manner.

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...This is also the opinion of C.C. Lamberg-Karlovsky[5], who believes that the copper used in the Indus Valley came from the Oman area in the Persian Gulf.

"However, it is now realized that metallurgy developed quite early in the region and there seems to be a relationship between known centers of metallurgy and known mineral deposits. Of all the areas bordering on the Indus river, Afghanistan seems to be the richest in mineral deposits and it is here that the first evidence of metal is to be found. At Mundigak in southern Afghanistan, metal first appears in level I4, in a context to be placed at the end of the fourth millennium BCE...The early appearance of tin-bronze at Mundigak reflects the existence of tin deposits in Afghanistan.

"It is in the Harappan period proper that the relations with Sargonic Mesopotamia are firmly established and the references to the ships of Meluhha appear in the Old Akkadian royal inscriptions...In the Harappan period metallurgy seems to have been introduced fully developed at such sites as Harappa and Mohenjodaro. The existence of copper, tin, and bronze are amply attested by copper and tin ingots from Harappa and bronze ingots from Chanhu-daro. Bronze is used not only for weapons and implements, but also for figurines. The bronze dancing girl from Mohenjo-daro, cast by means of the cire perdue process, is the most famous. In addition to tin, some of the Harappan metal objects, especially those from Harappa itself, have a high arsenic content.

"The archaeological evidence suggests that Mohenjodaro was an actual center for the manufacture of metal objects. A brick-lined pit containing copper ore was excavated there and this has been interpreted as a reducing pit for copper. From Harappa comes a furnace with channels through which a bellows must have forced a blast of air. From the Harappan levels at Chanhudaro come stone moulds for the casting of flat axes. Yet is maintained that, while the metal may have been melted and cast at the major Harappan sites themselves, the metal itself, and perhaps even the raw copper ore, was imported from the outside. The reason for this is that the copper and bronze objects from the Harappan civilization have a high nickel content. The presence of nickel as a trace element is said to mark the use of a copper ore from the Oman region.

"The actual significance, or better, the lack of significance of the presence of nickel as a trace element has already been discussed. The basi cpoint is that nickel is so common that it cannot possibly be used to identify an ore from a specific source...The excavator (of Lothal) S.R. Rao states:

The occurrence of bun-shaped ingots with 96.46% to 99.8% Mohenjodaro and Lothal suggests that copper was imported from sources, among which may be counted Susa and Oman. Bun-shaped ingots were found on third- to second-millennium sites in Oman (Hauptmann et al. 1988: 41, fig. 4:6); this is the shape in which Omani copper was traded in the Near East. Five circular bun-shaped ingots of copper were included in the mid-third-millennium BCE 'Vase a la Cachette' excavated at Susa. They have been associated with ingots of this shape found in the Gulf and in Indus Valley settlements (Tallon 1987: nos. 687-92, pls. 262-4). Two bun-shaped ingots were found in a contemporary context at Tell Chuera in Syria (moortgat and Moortgat-Correns 1978: 66ff., fig. 29a-b). Oxhide-shaped ingots were characteristic of the Mediterranean trade in copper in the Late Bronze Age.

"...North of Lothal are the copper mines of Rajasthan. Communication between Rajasthan and Lothal is by means of the great Sabarmati river. Between Rajasthan and Lothal is the province of Gujarat. D.H.Gordon suggeste that the distribution of Harappan sites along the Sabarmati river reflected the importance of the copper from Rajasthan. This suggestion can now be amplified on the basis of the material from the excavations at Rangpur in Gujarat...the ingots from Lothal show a high purity with no trace of arsenic present. The same lack of arsenic is characteristic of the bronzes from Rangpur...it is interesting that the province of Gujarat has been identified as the Meluhha of the Mesopotamian cuneiform texts. This would mean that references to the copper of Meluhha refer to the copper of

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Rajasthan shipped to Mesopotamia through the port of Lothal. Such a suggestion demands a trade which is the exact opposite of that generally held today. It would present Lothal as a port engaged in the export of copper whereas, as pointed above, it is generally assumed that Lothal served as a port for receiving copper imports...The name Meluhha, as used in these (cuneiform) texts, refers not to any particular deposit of copper ore, but to the area of the port from which this copper was shipped to Mesopotamia. The best evidence at the present time for such a port is said to come from the excavations at Lothal in the Gulf of Cambay..." (J.D. Muhly, 1973, *Copper and Tin*, Hamden, Connecticut, Archon Books, pp. 168-179; 121).

Antennae swords

Many types of Copper Hoard objects have been found: 1. anthropomorphic figure, Sheorajpur; 2,3. antennae swords, Fatehgarh; 4,5. harpoons, Sarthauli and Bisauli; 6. ring, Pondi; 7. hooks.

"Casal expressed his private expectation that in course of time a Copper-Bronze Age civilization would be discovered in South India…At the Fourth Conference of South Asian Archaeologists held at Naples in July 1977, V.I. Sarianidi showed an illustration of a copper or bronze sword, acquired in Kabul, but almost certainly emanating from the Dashli region of north-west Afghanistan. This piece has a form which is almost identical to that of one of the common types found in the Doab copper hoards. It is 50 cms. Long, with maximum blade width of 4 cms. And width of antennae of c. 3.25 cms. Both the length and ratio of length to width of antennae are well within the range of the Indian specimens. The discovery of this piece must in our view increase the probability that the Indian series as a whole show evidence of some sort of contact with northern Iran or the Bactrian region." [F.R. Allchin, A south Indian copper sword and its significance, in: : J.E. Van Lohuizen-de Leeuw, 1979, *South Asian Archaeology 1975*, pp. 106-118).

"Thermoluminiscence (TL) dates for the Ochre Colour Ware (OCW/OCP) from four sites, viz., Atanjikhera, Lal Qila, Jhinjhana and Nasirpur, in the Ganga-Yamuna valley indicate that these sites may have been contemporary, if somewhat late, with many of the Harappan settlements in the west. Of the eight TL dates, three fall between 2500 BCE and 2000 BCE, three between 2000 BCE and 1500 BCE and only two are slightly younger than 1500 BCE. At saipai, a site further southeast of Atranjikhera, this pottery has been demonstrated, by means of an excavation, to have been associated with the well-known Copper Hoards. While Saipai yielded some of the key-types, viz. harpoons, anthropomorphic figures, hooked spearheds, etc., the other types falling in this category are: antennae-hilt swords, simple as well as shouldered axes, bar-celts, rings. In this context it is worth recording that from the point of view not only of their typology, but also of metallic composition and manufacturing techniques, these Copper Hoards stand quite apart from the Harappan metal tools.

"Ganeshwar in Sikar District of Rajasthan. The area, well known for its Khetri group of copper mines, is drained by several rivers, one of which, viz. Ka_ntli_, seems to have joined the Chauta_ng in ancient times, and another, the Sota_, provides a link with the Yamuna_ via the Sa_bi_. These mines seem to have been exploited since antiquity and may well have provided copper to the Indus civilization.

"A chance find of as many as sixty copper celts at Ganeshwar led to an excavation, as a result of which not only more celts but chisels, spearheads, arrowheaqds, bangles and spiral-headed pins were also found, some of which are reminiscent of the Harappan types (Agrawala, RC and Kumar 1982). It must, however, be stated that, though black-on-red, the Ganeshwar pottery does nto fall in the Harappan category. Likewise, the absence of any typical Copper Hoard artifacts, such as the harpoon or the anthropomorphic figure, keeps Ganeshwar apart from the Hoards. As to the chronological horizon, the excavators assign the Ganeshwar complex to the second and third quarters of the third millennium BCE.

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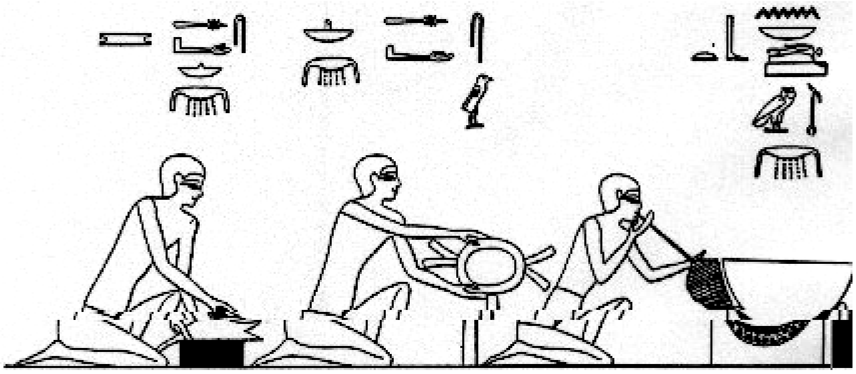
“Southwest of Ganeshwar, at the tail end of the Aravallis, are Ahar, Balathal and Gilund yielding a chalcolithic complex characterized by a white-painted black-and-red ware…Ahar has been known as Ta_mbavati Nagari, i.e.a ‘Copper city’, which implies local copper smelting, of which the excavation also gave some evidence (Sankalia et al. 1969). Radiocarbon dates from Ahar and Balathal place this culture between c. 2500 BCE and 1500 BCE…Bagor in District Bhilwara (Misra 1973), goes back to the mesolithic times (Period I), for which four radiocarbon dates, ranging from 5232 BCE to 3353 BCE are available, the site continued even upto the Iron Age. During Period II, which may be placed in the third millennium BCE, copper tools, including three hollow-based arrowheads and a broken spearhead, were found.” [B.B. Lal, 1997, *The earliest civilization of South Asia*, Delhi, Aryan books International, 23-25].

Silver

According to Ratnagar, “thre was no indigenous production of silver in India until a fairly late period, and that the Harappan silver came from Mesopotamia.” (Ratnagar, Shireen, 1981, *Encounters*, Delhi). Chakrbarti disagrees: “This statement does not appreciate the extent to which we have argentiferous galena in the lead-zinc deposits of Zawar and Agucha in Rajasthan. Besides, silver deposits are found as early as Nal.” …[Dilip K. Chakrabarti, 1990, *The External trade of the Indus civilization*, Delhi, Munshiram Manoharlal Publishers Pvt. Ltd., p.143].



Egyptian goldsmith at work. Detail from grave-relief at Sakkara, mid-third millennium BCE. Smelting and kindred processes were developed in Egypt during the fourth millennium BC, including the use of blow-pipe to attain temperatures of just over 1000 F needed to melt electrum ores. Beaten thin sheet of gold was 'plated' on to stone or wood in pre-dynastic times. Early third millennium BCE saw the development of furnaces for smelting.

Cementation to assay silver

http://members.xoom.com/mspong/metallurgy.html "The cupel must be heated red-hot for half an hour before any metal is put upon them, by which all moisture is expelled. When the cupel is almost white by heat the lead is put into it, and the fire increased till the lead becomes redhot, smoking, and agitated by a motion of all its parts, called its circulation. Then the silver is to be put on the cupel, and the fire continued till the silver has entered the lead; and when the mass circulates well, the heat must be diminished by closing more or less the door of the assay furnace. The heat should be so regulated, that the metal on its surface may appear convex and ardent, while the cupel is less red; that the smoke shall rise to the roof of the muffle; that undulations shall be made in all directions; and that the middle of the metal shall appear smooth, with a small circle of litharge, which is continually imbibed by the cupel. By this treatment the lead and alloy will be entirely absorbed by the cupel, and the silver become bright and shining, when it is said to lighten; after which, if the operation has been well performed, the silver will be covered with rainbow colors, which quickly

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undulate and cross each other, and then the button becomes fixed and solid.The diminution of weight shows the quantity of alloy. As all lead contains a small portion of silver, an equal weight with that used in the assay is tested off, and the product deducted from the assay-weight. This portion is called the witness. - Richardson's *Metallic Arts*."

http://www.library.upenn.edu/etext/smith/ercker/index.html#TOC See also Ercker's Treatise on mineralogy and metallurgy (1598) [A self-stoking furnace for cementation] [Furnaces for reducing calcined copper matte and alloying with lead for direct casting of liquation cakes] [Crucibles and molds for parting gold with antimony] [Furnaces for the fusion assay of copper ores] [Furnace for melting copper and lead, and casting liquation cakes] Furnaces for roasting and quenching gold ores] [Multiple muffle furnace for refining silver on tests]

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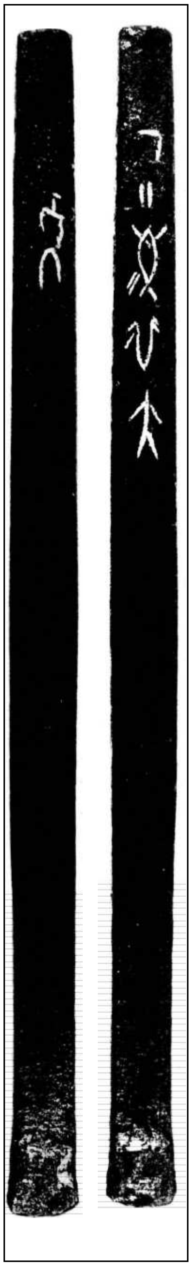

"Historical Development

"Perhaps as early as 4000 BC, metalworkers in the Middle East discovered that certain copper ores could be heated to produce a metal that was harder than copper, had a lower melting temperature, and was easier to cast. The ores contained tin and the alloy produced was bronze. The Bronze Age was born.

"By 3000 BC copper-arsenic, copper-gold, and lead-tin alloys were also in use. Brass, made from copper and zinc ores, appeared between 2000 and 1000 BC, but was not important until the Romans began to use it to make coins in about 200 BC. Great progress in metallurgy occurred under the Roman Empire. Medieval alchemists, attempting without success to transform other metals into gold, found many new alloys."(*Compton's Encyclopaedia Online*)

Indigenous technological framework

From the archaeological record, a substantially indigenous technological framework is apparent for the cultural development of the Sarasvati Sindhu River Basins. The archaeological record also provides evidence for close contacts, across the Persian Gulf, with the Mesopotamian civilization area ca. 3300-1500 BCE. Pre-urban settlements in the plains of the Sindhu in Sind province, the Sindhu and her tributaries in Punjab and the Sarasvati in the Marusthali_/Cholistan desert, in Rann of Kutch, in Saura_s.t.ra region, of Gujarat and close to the Gulf of Khambat, provide the context of the Civilization of Bha_rata, a process which began in the first half of the fourth millennium BCE.

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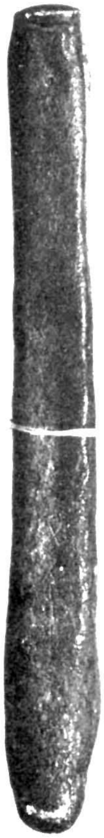
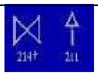
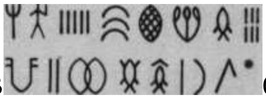
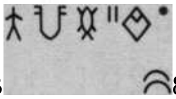
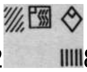
Inscribed weapons and tools



c-39A1c39A2  Sign 214 (turned vertically, to look like an X with top and bottom lines, similar to the sign which occurs on Anau stone seal) and Sign 211

c40Ac40B  6306 [Mahadevan corpus Text Number]

k121Ak121B  8302

k122A k122A2  8301

Mackay, E., 1943, *Chanhu-daro Excavations*, 1935-1936, American Oriental Society, New Haven, Connecticut]

Chanhu-daro Ivory comb with dotted circles. Chanhudaro. [After Mackay, 1943; Fig. 4, Pl. XCI.]

Linga-stone. Chanhudaro [After Mackay, 1943; Fig. 11, Pl. XCI.]

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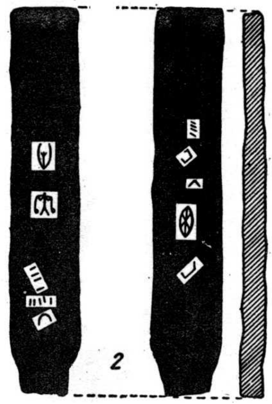
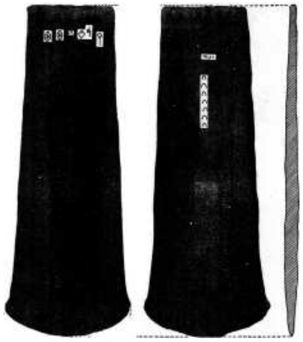
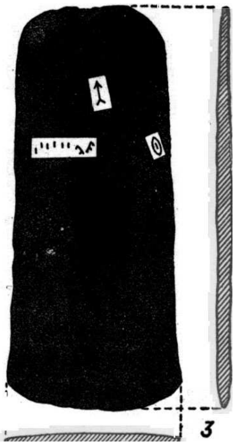
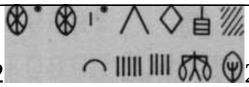
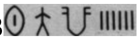
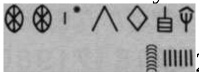


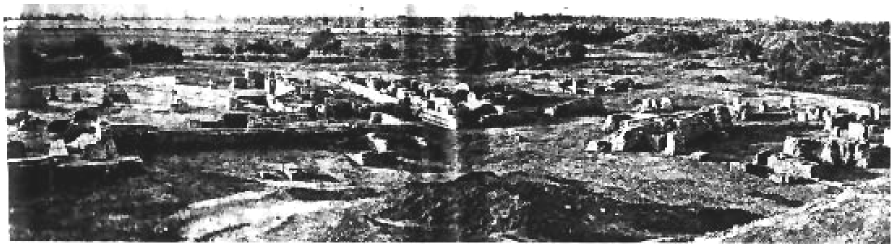




Mackay cxxvi2  2923
Mackay xvi3  2924 Mackay cxxvi5  2925
Mackay cxxvii1 [Four slanted strokes; 7 short numeral strokes]

[See: J.S. Pettersson, 1999, Indus Numerals on Metal tools, in: *Indian Journal of History of Science*, 34(2), pp. 89-108. "By internal evidence, then number of times a numeral can occur in sequence appears to be bound by eight. That is, if the different numerals together formed a system, as supposed here, that system was octal…it demolishes the hypothesis that the numerals represent weight units, at least the common units described by Hemmy (1938)."

Hemmy, A.S., 1938, System of Weights, in Mackay, 1938, pp. 601-612.
Hemmy, A.S., 1938, Appendix II. Relations to Egyptian and Susian Weights. In Mackay, 1938, pp. 672-678.
Mackay, E., 1938, *Further Excavations in Mohenjodaro*, Vol. I and II



Chanhu-daro. Buildings of Harappa_ II occupation, from north-east. [After Mackay, 943; Fig. , Pl. XV.]

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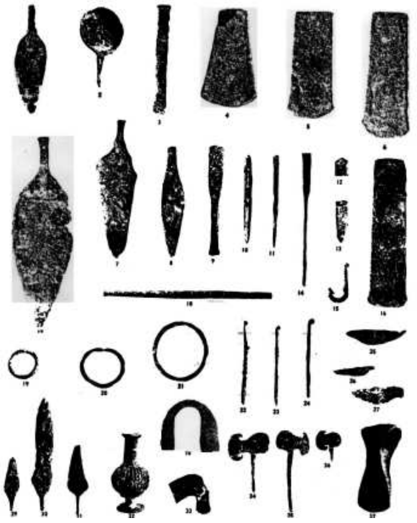
Chanhujo-daro. Models of chariot-box (copper/bronze), wheels, cart-frames. After Pl. LVIII, Mackay, 1943.

Copper and bronze tools and utensils.

Chanhujo-daro. **Item 1 is an axe blade with inscription on both sides.** After Pl. LXXIV, Mackay, 1943.

Copper and bronze implements and utensils. Chanhujo-daro. After Pl. LXXV, Mackay, 1943.

Copper and bronze implements and tools. Chanhujo-daro. After Pl. LXXVI, Mackay, 1943.



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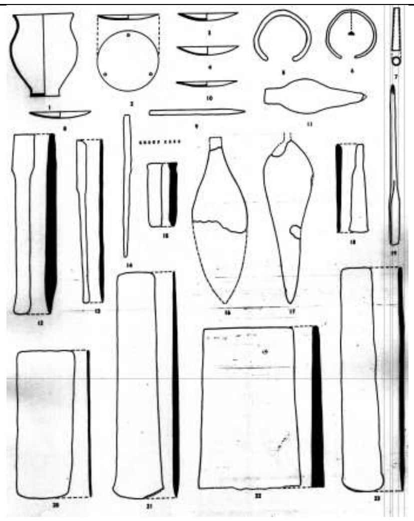
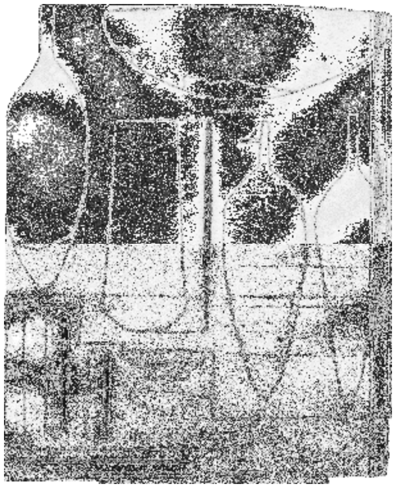
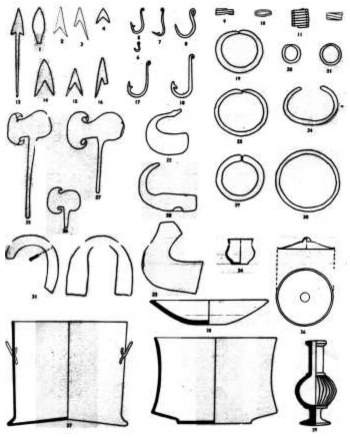


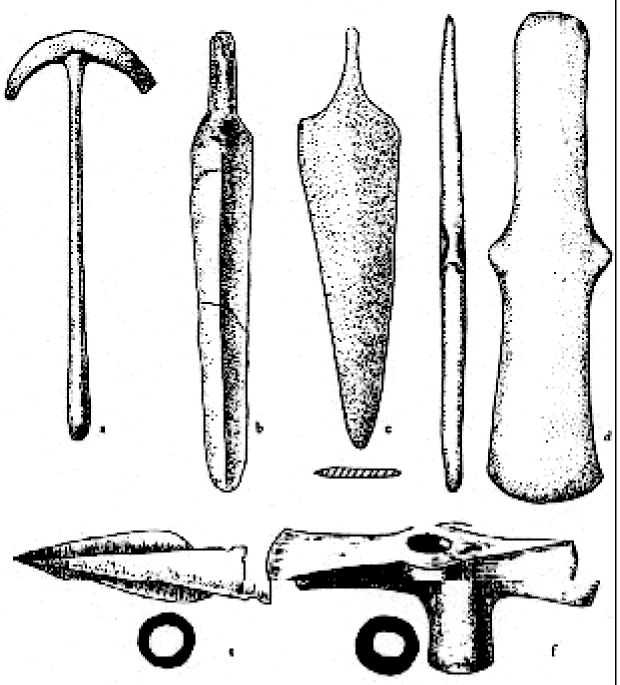
Copper and bronze tools and weapons. Chanhujo-daro. After Pl. LXIII, Mackay, 1943.



Copper and bronze tools and weapons. Chanhujo-daro. After Pl. LXII, Mackay, 1943.

Copper and bronze objects. Chanhujo-daro. After Pl. LXXIII, Mackay, 1943. [Ernest J.H. Mackay, 1943, *Chanhu-daro Excavations, 1935-36*, New Haven, American Oriental Society].





"...there is some ground to infer that the discovery of extraordinarily rich copper objects belonging to the Ganeshwar culture in a copper-rich area of the Aravallis in northeast Rajasthan underlines in some way this increased use of raw materials. This culture certainly belongs to the first half of the

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third millennium BCE. Among other things, the Ganeshwar-type of artifacts have been found in the early Harappan assemblage at Kalibangan and at the mesolithic level at Bagor in southeast Rajasthan. The point is that this small site in Rajasthan yielded more than a thousand copper artifacts and there are forty-six Ganeshwar-type sites in the list prepared by J.P. Joshi, Madhu Bala and J. Ram (1994). The presence of reserved-slip ware at these sites strongly suggests a Harappan link, and I infer that, beginning with the early Harappan level, this area of Rajasthan was a highly flourishing centre for copper metallurgy and that its relationship with the early Harappan level at Kalibangan and probably beyond, as far as Cholistan, supports my assumption of craft-specialization as a distinct variable leading to the emergence of the Indus Civilization." (Dilip K. Chakrabarti, 1995, *The archaeology of Ancient Indian Cities*, Delhi, OUP, pp. 51-52).

Independent centres of metallurgical production in the early Bronze Age of Turkmenistan are seen in the settlement of Khapuz depe where copper smelting furnaces were uncovered (Sarianidi 1976: 82-3). Pottier believes that the influence of the Indus can be detected in BMAC (Bactria Margiana Archaeological Complex) metalwork.

Weight in the Form of Standing Bull Provenance Bactria; Period Late 3rd - early 2nd millennium BCE; Materials Lead; Dimensions H-26 W-32.4 http://www.miho.or.jp/booth/html/doccon/00001220e.htm

Metal artifacts of the Bronze Age from southern Turkmenia. a,c.d Altin-depe; b Anau; e Ashkhabad; f Daina (After fig. 30 in: V.M. Masson and V.I. Sarianidi, 972, *Central Asia: Turkmenia before the Achaemen**ids*, New York, Praeger Publishers) Lead and arsenic was often added to the bronze. Some objects from Namazga-depe contained as much as 8-0 lead and in one case the artifact was even made of brass (an alloy of copper and zinc). Twin moulds were used for casting; precious metals including gold and silver were also used. There are analogies of metal artifacts in the Harappan assemblages; for example, flag daggers without a midrib which were quite atypical for Hissar, were very widespread both in southern Turkmenia and in the Indus Valley.

Artifacts including golden head of bull. Southern Turkmenia, Margiana, Bactria: 4-7 golden head of bull and seals from Altyn depe (Developed Bronze Age); 8-21 seals and amulets of

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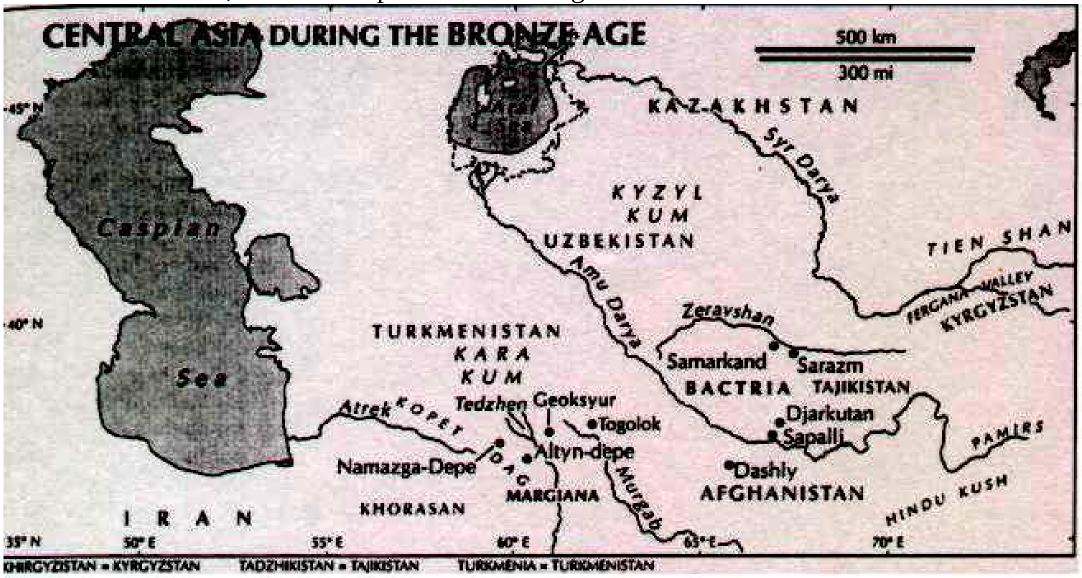
Bactria and Margiana (After Fig.4 in L.P'yankova, Central Asia in the Bronze Age: sedentary and nomadic cultures, in: *Antiquity* 68 (1994): 355-372).4.4 golden head of a bull with a turquoise sickle inlaid in the forehead; 4.5: steatite plate with an image of cross and half-moon.



Map of Central Asia during the Bronze Age

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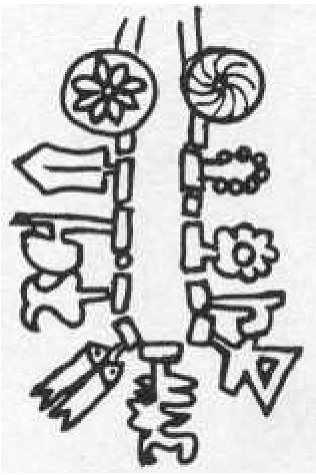
Tradition of sacred weapons

Iconography of weapons and epigraphs on weapons

In the development of Indian iconography, a notable feature is the weapons – a_yudha_ni -- which adorn many deities. The story of Indian art and architecture can be told by an analysis of the evolution of weapons and accoutrements of the s'ilpa's and the adornments on ancient buildings, temples and be_ra (mu_rti or idols) carved in stone and moulded in bronze. Bha_rat Kala_ Bhavan of Banaras Hindu University, Varanasi has a collection of arms and armour in the Indian tradition, mostly dated between the 16th to 19th centuries AD. It is no coincidence that the inscribed objects are mostly relatable to the products made by armourers -- weapons and equipment of a warrior. It appears that the archaeology and philology related to these objects are testimony to the battles and wars recorded in the R.gveda and the Maha_bha_rata. The inscribed objects were thus either bills of lading containing the products of the armoury or lists of weapons and accoutrements of a warrior or of a metalsmith who possessed the inscribed object. The recording of property transactions on copper plates is an ancient Indian historical tradition. It appears that this is a legacy of the practice of the armourers of the Indian civilization at Mohenjo-daro recording the weapon lists on copper plates. There are also inscriptions incised on arms themselves (on copper blades, on knives, on bronze rods) -- a process which could have been accomplished only by metal-workers. Many products made by armourers were traded in neighbouring civilizations, in Mesopotamia, in particular. The tradition of Bha_rata records the events related to battles and wars in the Great Indian Epic, the Maha_bha_rata and also in the R.gveda. The tradition also dates the start of the Kaliyuga from 3012 BC, a date close to the great war recorded in the epic. The war was fought on the banks of the River Sarasvati. It is on the banks of the same river system (including the tributary S'utudri_), archaeological sites such as Rakhigarhi, Banawali, Kunal, Kalibangan, Rupar and Dholavira have yielded inscribed objects containing many pictographs (over 100 field symbols) and signs (over 400).



Mahis.a_suramardini. North India, 5th cent. AD, Reddish-brown terracotta, 9.6 X 12 cm. MIK I 10143. Note the sword in Durga_'s right hand and the shield on her left. The two symbols adorn, as pendants, the as.t.aman:galaka ha_ra of the Sa_n~ci yaks.i.

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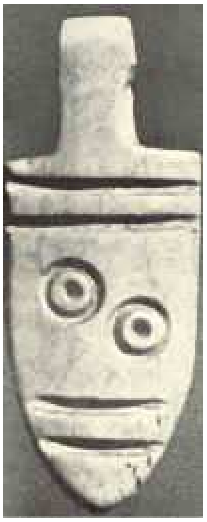
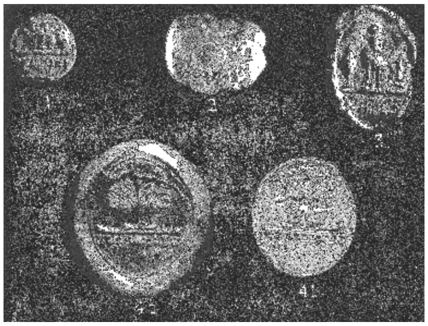
"This female figure armed with sword and shield, is a depiction of Durga_. In popular myths she is described as an annihilating (mardini) godess who destroys the buffalo demon (Mahis.a_sura). The figure of Durga in the act of slaying the buffalo demon is always depicted with many arms. From the Gupta period onwards, she is shown holding weapons than in earlier images. The bow and arrow, especially the trident (tris'u_la), and as in this image, the sword and shield, are her typical attributes. A terracotta find depicting the Mahis.a_sura-mardini theme dating from the 1st cent. BCE (Srivastava SK 1996,*Terracotta Art in Northern India*, Delhi: 231) establishes that Durga images are among the oldest in Hinduism. Nonetheless, as with many other deities, the full iconography of the godess evolved only in the Gupta era. The presence of a large number of images underline the great popularity of this godess. For a devout Hindu, the subjugation of the buffalo-demon, the embodiment of dark forces, symbolizes, above all, the triumph of good oveer evil, and it is still celebrated in many regions of India in a festival lasting ten days (Navara_tri/Durga_-Pu_ja). This small, sculptured image is remarkably expressive. Using simple means, this artist has focused on the terrifying and powerful aspects of the godess, which, by no means, are characteristic of all Durga images. Durga manifests not only the female energy of S'iva but is also the ruler of the mother godesses (Ma_tr.ka-s), who are normally described as malevolent divinities. Durga creates them on the battlefield during her combat with the demons." (*Treasures of Indian Art: Germany's Tribute to India's Cultural Heritage*, 1999, Delhi, National Museum, Roth, G., Fig.31)



Dagger-shaped pendant, ivory, Taxila, 4th-3rd centE. BC: 4.8 cms. One one side of the blade there are decorations of deeply cut parallel lines and two dotted circles. The obverse is plain. The handle has a small hole for suspension (After *Taxila*, III, pl. 199, no. 14). Most pendants of bone or ivory found are dagger-shaped pendants. Two such specimen are assigned to the Bhir mound. (After *Taxila*, II, p.654; III, pl. 199, nos. 13 and 14). Other specimen are from Sirkap and Hathial (ibid., nos. 15,16). A dagger-shaped pendant made of bone measures 4.7 cm. One side is incised with six dotted-circles on the handle and on the blade. The handle has a hole for suspension. (ibid., no. 13).

This pendant is comparable to the dagger-shape shown as a pendant on the as.t.aman:galaka-ha_ra depicted in the sa_n~ci yaks.i sculptures.

Sealing bearing the device of a lion and the legend Sena_pati In(dra)..., Bhita, Indian Museum, Calcutta, no. A 12247-NS. 1446. In front of the lion is the symbol, s'ri_vatsa.



1. Sealing of Dan.d.ana_yaka Satya (vrata?), Rajghat, Bharat Kala Bhavan, no. 6372; 2. Sealing of Dan.d.ana_yaka Anuttara, Rajghat, Bharat Kala Bhavan, no. 6376; 3. Sealing of Dan.d.ana_yaka S'an:karadatta, Bhita, Indian Museum, Calcutta, no. A. 11227-NS 1547; 4a. Seal of Dan.d.ana_yaka Ksa (Ska)nda, Rajghat, Dept. of AIH, C and Arch., BHU, no.1; 4b.

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Plasticine impression of (a).

Notes: "Several clay seals and sealings from Rajghat belong to a class of officers known as dan.d.ana_yaka-s...The letter (on 4a)*ksha* is, in all probability a mistake for *ska*. The peacock, va_hana of the god Skanda, was appropriately chosen by the namesake. Another sealing from the same site with a chakra flanked by a spear on the left aqnd a crescent on the right has the legend Dan.d.ana_yaka Anuttarasya in early Gupta characters (pl. IX,2). A third of the same provenance shows a bull recumbent on the left and the legend Dan.d.ana_yaka Satya(vratasya) (pl. IX,1)...All these are obviously derived from dan.d.a which means 'army', a 'rod' as well as 'punishment'. There is no unanimity among scholars regarding the exact connotation of these words. Stein, Marshall, Vogel and Bhandarkar interpret the expression to mean a police officer; Beni Prasad, Bloch, Mookerji, Banerji, Sankrityayan and Dikshitar interpret it to stand for a judge. Raychaudhuri, Fleet, Altekar and Dr. Sircar take it to denote an 'army officer' while Marshall, elsewhere, was undecided about its exact meaning and translated it as 'chief judge' or 'chief officer of police'. If bala_dhikr.ita (also maha_bala_dhikr.ita) and dan.d.apa_s'ika were officers of the army and police respectively, it would be reasonable to suppose that the dan.d.ana_yaka, in the main, was a judicial officer. Would the symbols on these seals and sealings help us in understanding the meaning of this term and the duties and office of that officer? It is significant that the eight dan.d.ana_yaka sealings from Bhita invariably bear the bull-la_n~chana. Apart from being a S'aiva device, the bull is also symbolic of Dharma. This symbol would really be the most appropriate for a judge who has to follow the tenets of the law scrupu;lously and enforce it impartially. The bulls on the two Gupta sealings have a spherical object between their horns (Pl. IX, 3)...But the sealings from other sites noted above bear either the same device (bull) or have a chakra, peacock, etc...the chakra being reminiscent of the sudars'anachakra of Vis.n.u and the peacock of the va_hana of Maha_sena-Ka_rttikeya, the General of the Gods...In literature and later epigraphs, the term dan.d.ana_yaka (or maha_dan.d.ana_yaka) has sometimes been used to denote a military officer or an administrator. Sometimes the term is found combined with other offices (e.g. with kuma_ra_ma_tya and sa_ndhivigrahika). The office could also be hereditary. The title was also, at times, used by the feudatories, perhaps as a mere honorific." (K.K. Thaplyal, 1972, *Studies in Ancient Indian Seals*, Lucknow, Akhila Bharatiya Sanskrit Parishad, Pl. IX, Figs. 1 to 4; pp. 115-118).

Clay lump bearing impressions of the seal of the offices of (a) kuma_ra_ma_tya and (b) bala, Ahichchatra_, Antiquity section of the Arch. Surv. of India, New Delhi, no. AC II 4448; 2. Sealing of the military office attached to the Yuvara_ja-bhat.t.a_raka, Basarh, Indian Museum, Calcutta, no. A. 11315--NS 6159. (After K.K. Thaplyal, 1972, *Studies in Ancient Indian Seals*, Lucknow, Akhila Bharatiya Sanskrit Parishad, Pl. XIII, Figs. 5 and 6; pp. 110-120).

"A sealing from Ahichchatra in the Antiquity section of the ASI, New Delhi, shows a vase-and-foliage motif and the legend bala_dhi in Gupta characters...One of the impressions on a lump from the same site in the same collection has a similar device and the legend bala_dhikaran.a in characters of the same period. Another impression is that of Kuma_ra_ma_tya_dhikaran.a (Pl. XIII, 5)...Another Basarh sealing has the device of a vase with foliage in the centre, a s'an:kha to the right and the letter s'ri_ to the left. The legend reads: 1. yuvara_ja-bhat.t.a_raka-; 2. pa_di_ya bala_dhi-; 3. karan.asya 'military office attached ot the yuvara_ja bhat.t.a_raa' (Pl. XIII, 6). [Banerji, however, translates the term as '(The seal) of the office of the Commander-in-chief, equal in rank to the heir-

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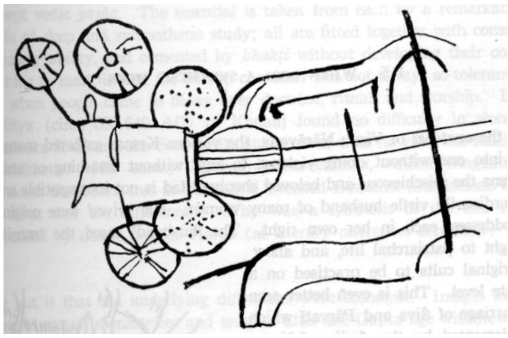
apparent' (AIG, 74); Bloch translates it as '(Seal) of His Highness the Yuvara_ja (and) Bhat.t.a_raka, the chief of military forces' (ASIAR, 1903-04, p. 108)]...according to the commentary of Kullu_ka on the Manusmr.ti (VII.189), the sena_pati had under him ten pattika-s (the smallest leaders of the army) while the sena_na_yaka or a bala_dhyaks.a ten sena_pati-s. In a Pa_la epigraph we find the mention of a sena_pati and a bala_dhyaks.a as two different officials." (ibid., p. 120).



"That Kr.s.n.a had risen from the pre-Aryan people is clear from a Pa_n.inian reference (Pa_n. 4.3.98, explained away by the commentator Patan~jali) to the effect that neither Kr.s.n.a nor Arjuna counted as ks.atriyas. But his antiquity is considerable, for he is the one god who uses the sharp wheel, the missile discus, as his peculiar weapon. This particular weapon is not known to the Vedas and went out of fashion well before the time of the Buddha. Its historicity is attested only by cave paintings (fig. 1.17) in Mirza_pu_r which show raiding horse-charioteers (clearly enemies of the aboriginal stone-age artists) one of whom is about to hurl such a wheel. The event and the painting may fairly be put at about 800 BCE by which date the dark god was on the side of the angels, no longer an aborigine himself." (See JRAS 1960, 17-31, 135-144 or chapter IV of this book. for the cave painting (originally discovered by Carlleyle) Mrs. B. Allchin in Man, 58, 1958, article 207 + plate M (pp. 153-5); D.D. Kosambi, 1962, *Myth and Reality*, Bombay, Popular Prakashan, p. 26).

What is myth and what is reality in these opinions of Prof. DD Kosambi? Maybe, the date of the painting is 800 BCE. But is it a fact that the discus weapon was not known to the Vedas?[6]

It would appear that the cakra as a weapon was attested in the R.gveda and Atharva Veda, and also in inscriptions of the Sarasvati Sindhu Civilization.

The appearance of pictographs of spoked wheels in the Civilization should come as no surprise since, in contemporary times, there was evidence for such wheels in the Near East: “The appearance of wheeled vehicles in Europe and the Near East during the 4th millennium BCE is a major socio-economic development. In the past, eminent archaeologists such as Childe (1951), Piggott (1979; 1983) and, more recently, Sherratt (1981; 1997) have argued for diffusion of wheeled vehicles from the Near East to Europe. In contrast, other archaeologists as e.g. Hausler (1992) and Vosteen (1996) stressed the local development of wheeled vehicles in Europe. The question of diffusion versus independent development is an old issue in archaeology. Judging by the archaeological data in the 1990s, it seems that wheeled vehicles developed more or less simultaneously or diffused very fast from Mesopotamia to Europe. We favour the latter possibility. It is difficult to explain how this technological transmission occurred in the 4th millennium BC, but Europe and the Near East were never isolated from each other during this period.”

[Jan Albert Bakker, Janusz Kruk, Albert Lanting, Sarunas Milisauskas, 1999, ‘The earliest evidence of wheeled vehicles in Europe and the Near East’, *Antiquity*, January 1999, Vol. 43, No. 282, p. 778].

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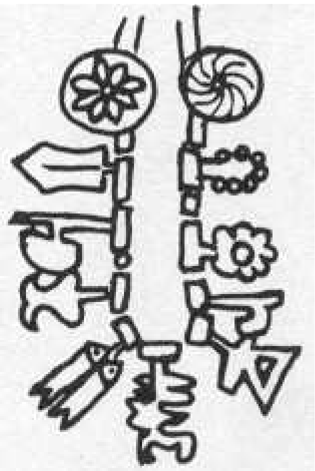

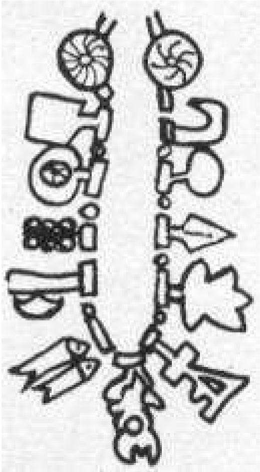

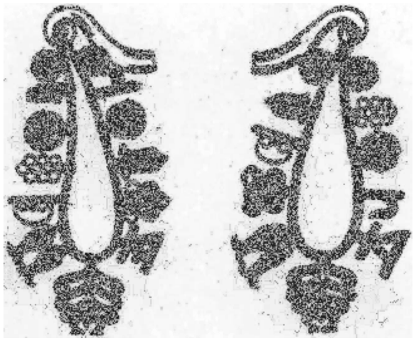

Necklaces with a number of pendants Man:galaka ha_ra depicted on a pillar of a gateway (toran.a) at the stu_pa of Sa_n~ci, Central India, 1st century BCE. [After VS Agrawala, 1969, *The deeds of Harsha (being a cultural study of Ba_n.a's Harshacharita*, ed. By PK Agrawala, Varanasi: fig. 62] The ha_ra or necklace shows a pair of fish signs together with a number of motifs indicating weapons (cakra, paras'u, an:kus'a), including a device that parallels the standard device normally shown in many inscribed objects of SSVC in front of the one-horned bull.

(cf. Marshall, J. and Foucher, *The Monuments of Sanchi*, 3 vols., Callcutta, 1936, repr. 1982, pl. 27). The first necklace has eleven and the second one has thirteen pendants (cf. V.S. Agrawala, 1977, *Bha_rati_ya Kala_*, Varanasi, p. 169); he notes the eleven pendants as: sun, s'ukra, padmasara, an:kus'a, vaijayanti, pan:kaja, mi_na-mithuna, s'ri_vatsa, paras'u, darpan.a and kamala. "The axe (paras'u) and an:kus'a pendants are common at sites of north India and some of their finest specimens from Kausambi are in the collection of Dr. MC Dikshit of Nagpur." (Dhavalikar, M.K., 1965, *Sa_n~ci: A cultural Study*, Poona, p. 44; loc.cit. Dr.Mohini Verma, 1989, *Dress and Ornaments in Ancient India: The Maurya and S'un:ga Periods*, Varanasi, Indological Book House, p. 125).

Note that one of the pendants looks like the 'device' normally found in front of the one-horned bull, the san:gad.a, portable brazier and lathe (also meaning, battle).

On the second ha_ra, clock-wise, after in.aikkayal or mi_nayugala (twin fish), and axe, the pendant looks like a tree or a bunch of coral? **[tukir = coral, paval.am; vaicayanti = tukir-kot.i, i.e. creeper containing coral; thus a sign interpreted as a man:gala sign, i.e. vaijayanti may be connoted by this Tamil phrase: tukir-kot.i, i.e. a bunch of corals on a creeper. In Skt., vaijayanti can be interpreted as an attribute of victory].** Homonym: tukilikai = writing instrument (Ta.lex.)

This ha_ra with 13 pendants may be a combination of 8 welfare insignia (as.t.aman:gala) *plus* 5 weapons (aimpat.aitta_li). Kuber'a navanidhi also includes padma and s'an:khu. If s'an:khu connotes

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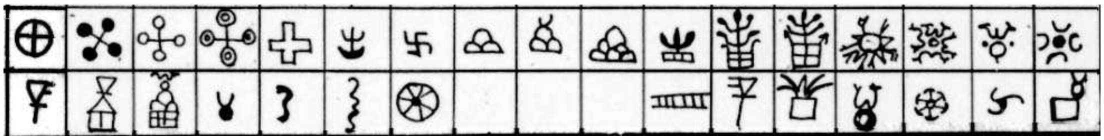
a javelin, what did padma connote in the repertoire of weapons? Or, is it just a symbol of plenty since it is said to contain many seeds. The Tamil idiom is: can:ka niti, patuma niti: "can:kaniti patumaniti iran.t.um tantu": te_va_ra. tan-ittirutta_n.t.aka. Tiruna_) explained in the Katirvel Pillai's Tamil lexicon as 'nidhi' (treasure) heaped like a s'an:kha and like a padma.

[Pl.4,J to P, Amaravati punch-marked coin symbols]



[Pl. 5, h, I, Kaus’a_mbi_ punch-marked local coin symbols]

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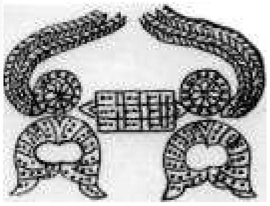
Dva_rapa_la. Stu_pa , Sa_n~ci , East Gateway, c. 300 BCE [cf. 'Monuments of Sanchi', Voll. II, Pl. 66a]

aimpat.aitta_li = a gold pendant worn by children in a necklace bearing in relief the five weapons of Vis.n.u, as an amulet (aimpat.aitta_li...kur-unat.aip putalvarkku: Man.i. 7,56)(Ta.lex.).



Aimpat.aitta_li: five weapons worn on the man:gal.asu_tra -- or protective necklaces -- parallels the tradition of as.t.aman:gal.a (eight symbols of welfare)

Note the necklace and bracelets on the right arm worn by the warrior holding a javelin on his left hand. The pendants strung on the necklace are not clearly legible on this photograph.

A Comprehensive Etymological Dictionary of the Tamil Language (TED), Vol. I, Part III, 1997. aimpat.aitta_li = gold pendant worn by children in a necklace bearing in relief of five weapons of Vis.n.u, as an amulet (aimpat.aitta_li kur-unat.aip putalvarkku: Man.i 7.56; can:ku, cakkaram, vil, va_l. mar-attan.tu (katai) incised in ta_li or man:galasu_tra) The picture on p. 327 of TED shows these five weapons in the central part of the lotus-bud shaped pendant.

On both the ha_ra, the padma is depicted as a circle with petals.

[Note: Hopefully, sharper photographs may help identify the weapons displayed as pendants more precisely].

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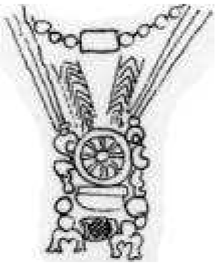
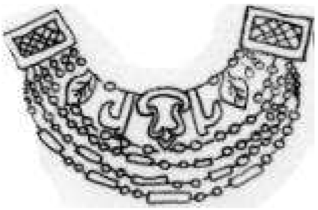


1. Tri-ratna necklace of Sirima Devata [Cunningham, *Bharhut*, pl. XXIII,]; 2. Yaks.in.i wears a short and a long necklace; the latter has a prominent spoked-wheel in the center, below which are cylindrical bead and egg-shaped bead flanked by two tri-ratna symbols [Cunningham, *Bharhut*, pl. LII, Joshi, LAU, Fig. 653] [After Figs. 23 and 233 in: Dr.Mohini Verma, 989, *Dress and Ornaments in Ancient India: The Maurya and S'un:ga Periods*, Varanasi, Indological Book House, p. 24.]

Chanda Yaks.i (c. 200 BCE, Indian Museum, Calcutta) wearing a seven-string necklace; the drawing shows lower three pearl strings consisting of flat stones or cylindrical beads; the upper row has



symbols including: papal leaf, elephant goad, s'rivatsa (which is the middle)[Cunningham, *Bharhut*, pl. L.7]] [After Figs. 232 and Pl. XI in: Dr.Mohini Verma, 989, *Dress and Ornaments in Ancient India: The Maurya and S'un:ga Periods*, Varanasi, Indological Book House, p. 24.] A figure on a mithuna plaque from Ahicchatra is interpreted: 'There are three additional symbols woven in her long necklace, namely a dagger on the left, a puppet (s'rivatsa in the center) and on the right, a vajra with a pointed angle prongs.' These symbols also occur on a terracotta of Mathura. [VS Agrawa,a Terracotta figurines ofAhichchatra, Dist. Bareilly, UP, *Ancient India*, No. 4, pl. XXXII,
2; VS Agrawala, Mathura Terracottas, *JUPHS*, Vol. IX, fig.6,0,2,3).

Vajra in the R.gveda is called **vazra** in the Avesta. S'atapatha Bra_hman.a (3.4.4.14) refers to the deva-s preparing a weapon called **vajra**; it is said to possess parts equal to an arrow, **ani_ka**, **s'alya** and **kulmala** (Eggelng, 1885: 108, n.2 explains these parts as: point, barb of the arrowpoint and connecting piece or shaft, tejana). Thus, a vajra has barb, a point and a shaft. S'Br. (8.5.1.13) refers to daks.in.aaudya_mo hi vajro which is translated as: 'the thunderbolt has a sling on the right side'. Udya_ma as 'extension;' may also mean a protruding part, serving as a handle (Eggeling 1897: 86, n.2). Udya_ma indicates that the weapon was raised to be swung and thrown spinning (pra-vr.t). A vajra is **ks.urapavi** (with a sharp rim)(JBr.). It has four edges (**caturas'ri**: RV). RV 2.16.6: vr.s.a_ te vajra uta te vr.s.a_ ratho. All the qualities described in the texts are fully application in the depiction of vajra in the sculptural tradition of Bha_rata.

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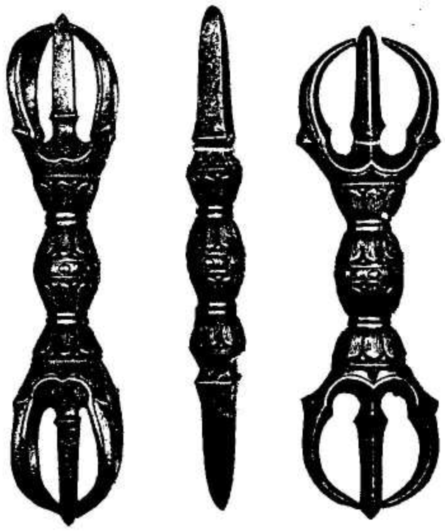
Note the tiger, elephant, Ba_lakr.s.n.a and S'rivatsa symbol depicted on a pair of royal earrings. Ca. 1st cent. BCE. India (Probably Andhra Pradesh). Gold. 1 ½ X 3 X 1 9/16 in. Metropolitan Museum of Art, New York.



Vajra, dorge, tokko. "The first name is Sanskrit, the second Tibetan and the third Japanese. The Buddhist symbol of the thunderbolt. It may have a single prong at each end, or three or five. In Japanese the names are tokko (single-pronged), **sanko** (three-pronged) and goko (five-pronged). The single pronged form makes a spoke of the wheel of the law. The vajra, usually one of three prongs, is used as a hilt on temple swords; and is frequently carved on Japanese blades." [Collection of Mr. RH Rucker. GC Stone, Figs. 830, 831, p. 652].

Given this remarkable cultural tradition, it is reasonable to formulate a hypothesis that the seals and sealings of the civilization are lists of weapons and devices/equipment used by smelters and metalsmiths. The man:gala-ha_ra may connote a marriage ta_li (man:gala su_tra) tied by the bridegroom indicating the list of property items he brings to the bride-to-be. However, it is noticed that Viru_pa_ks.a on the sa_n~ci sculptures is also shown bearing a javelin, wearing bracelets and a necklace with pendants. It is possible that this tradition later evolved into the form of amulets, as a form of protection from evil. As will be noted below, a seal with Bra_hman.i bull pictorial motif and a typical inscription has been found as a sealing for packaging goods; in this case, the inscription serves the function of a bill of lading. Since hundreds of signs and pictorial motifs are read using the rebus method as items of weapons, arms and armour, the keys to the decipherment are presented as the products of an armourer, kut.ha_ru represented by the homonym, the Bra_hman.i bull, kut.ha_ru. As a logical extension of this methodological key, the one-horned bull may be seen as a ligature composed of: a curved horn, neck highlighted by rings, one side of a pannier and the young heifer bull -- these four images may connote A SET of four distinct battle weapons: san:ga (horn, battle or sa~_ga one fork of a forked stick; sa~_gi = spear(S.); gad.a (neck, mace), san:kara (sack, ?s'an:ku, javelin, spike) and vahr. (heifer, val. -- sword).

This hypothesis will be elaborated and tested further using the entire corpus of inscriptions, objects in the round, including the pictorial motifs, their ligatures and the so-called signs most of which are pictographs and ligatures.

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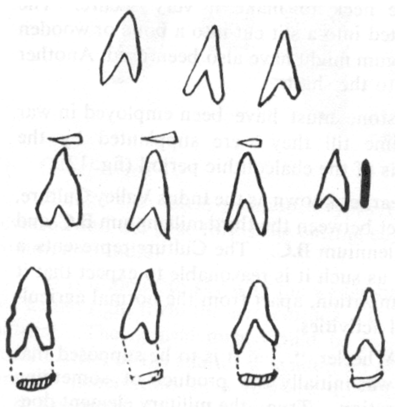
The tradition of valour and use of weapons in ancient Bharat

Early weapons were the bow and arrow celebrated as Dhanurvidya, a term which gets used, during historical periods, to denote warfare training, in general.



Thin, flat pieces of arrowheads made of copper having long barbs and without tangs. Wooden shafts over-lapped these arrow-heads, thus making a medial rib. Mackay notes that the tie-holes were to facilitate the insertion of wooden shafts. These arrowheads are identical to those from Zafer Papoura, Crete. Av. length: 1.19 inches, breadth 0.64 inches and thicknes 0.07 inches. Harappa. After EJH Mackay.

A chronological analysis of the evolution of weapons, and accoutrements with reference to archaeo-metallurgy and with reference both to the a_gamas and the archaeological finds, is yet to be undertaken.

Archer and bow in Vedic texts

The su_kta RV 6.75 is addressed to parts of battle by r.s.i pa_yu bha_radva_ja; (devata_: parts of battle):: 1. varma; 2. dhanu; 3.jya_; 4. a_rtni_; 5. is.udhi; 6. pu_rva_, sa_rathi_, utta, rays; 7. many horses; 8. ratha; 9. ratha gopa; 10. bra_hman.a, pitr., soma, dya_va_ pr.thivi_, pu_s.a_; 11-12, 15-16. is.u samu_ha; 13. pratoda; 14. hastaghna; 17. yuddhabhu_mi, Brahman.aspati, and aditi; 18. varma-soma-varun.a; 19. devabrahma

The bow is adored in the R.gveda as a mighty weapon in battle.

इन्द्राग्नी आ हि तन्वते नरो धन्वानि बाह्वोः ।
मा नो अस्मिन् महाधने परा वर्क् गविष्टिषु ॥

(bharadva_ja ba_rhaspatya) 6.059.07 Indra and Agni, men verily stretch their bows with their arms, but do not you desert us contending for cattle in the great combat.

Dhanvana_ ga_ dhanvana_jim jayema dhanvana_ ti_vra_h samado jayema
Dhanah s'atrorapaka_mam kr.n.oti dhanvana_ sarva_h pradis'o jayema

RV 6.075.02 May we conquer the cattle (of the enemies) with the bow; with the bow may we be victorious in battle may we overcome our fierce-exulting (enemies) with the bow; may the bow disappoint the hope of the foe; may we subdue with the bow all (hostile) countries. [Exulting: samadah: sa, with; amda, exhilaration; or, sam, entirely; ad, who devours (*Nirukt*a 9.17, 9.18)].

The bow ensures the defeat of the enemy.

bahvona_m pita_ bahurasya putras'cis'ca_ kr.n.oti samana_vagatya
is.udhih san:ka_ pr.tana_s'va sarva_h pr.s.t.e ninaddho jayati ;pr.su_tah

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6.075.05 The quiver, the parent of many, of whom many are the sons, clangs as it enters into the battle; slung at the back (of the warrior), prolific (of its shafts), it overcomes all shouting hosts. [Shouting hosts: san:ka_h pr.tana_h: san:ka_ = sounding together, sam ka_yanti; Ya_ska, Nirukta 9.14: san:ka_: from sac, to be assembled or sam, with; kr., to be renowned, armies in which there are assembled, or celebrated warriors]. This r.ca notes that **is.udhi** (lit. arrow-holder or quiver) is slung on the back. Other words for quiver are **tuna** or **tunira** (MBh.) and **kanda (***Ja_taka*-*s***)..** Persian names are: **tarkash, jaibah**.

The battle is fierce. Warriors assemble with uplifted banners (see the imagery depicted on SSVC inscribed tablet].

यत्रा नरः समयन्ते कृतध्वजो यस्मिन्न् आजा भवति किं चन प्रियम् ।

यत्रा भयन्ते भुवना स्वदृइ१२९षईशास् तत्रा न इन्द्रावरुणाधि वोचतम्॥

7.083.02 Where men assemble with uplifted banners, in whatever conflict, there is something unfavourable; where living beings, looking to heaven, are in fear, there, Indra and Varun.a, speak to us (encouragement). [There is something unfavourable: 'everything is evil'; yatra ca yuddhe bhuvana_, bhuvana_ni, bhu_taja_ta_ni svardr.s'ah, s'ari_rapatad u_rdhvam svargasya dras.t.a_ro vitas' ca bhayante, bibhyati, tatra, tadris'e san:gra_me he indra_varun.au no'sman adhivocatam, asmatpaks.apa_tavacanau bhavata_m = in whatever (battle) living beings and those seeing heaven (i.e. gone to heaven, departed) are in fear, there, Indra and Varun.a, plead our cause].

yatra ba_n.a_h sampatanti kuma_ra vis'ikha_ iva
tamra_ no brahman.aspatiri_datih s'arma yacchatu vis'ca_ha_ s'armam yacchatu

6.075.17 Where arrows alight like shaven-headed boys may brahman.aspati, may Aditi, grant us happiness every day. [Like shaven-headed boys: kuma_ra_ vis'ikha_ iva, like boys without the lock of hair left at shaving; mun.d.ita_ mun.d.ah, shorn-headed; the arrows fall where they like, as boys before they are left with the lock of hair, before the religious tonsure, play about where they like].

The bow-string is stretched upto the ear and embraces the ear like a damsel embracing her lover; the string whispers softly and darts on to her target.

vaks.yantoveda_ ganoganti karn.am priyam sakha_yam parivasvaja_na_
yos.evam s'in:kte vitata_dhi dhanvan jya_ iyam samane parayanti_

6.075.03 This bowstring, drawn tight upon the bow, and making way in battle, repeatedly approaches the ear (of the warrior), as if embracing its friend (the arrow), and proposing to say something agreeable, as a woman whispers (to her husband).

The ends of the bow are like two mothers who take the arrow on their lap like two mothers taking their children on their laps.

ye a_caranto samaneya yos.a_ ma_teva putram vibhuta_mapisvaye
apa s'atru_nbidhyata_m sambida_ne a_tni_m ime bis.phuranti_ abhinna_na

6.075.04 May the two extremities of the bow, acting in concert, like a wife sympathizing (with her husband), uphold (the warrior), as a mother nurses her child upon her lap; and may they, moving

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concurrently, and harassing the foe, scatter his enemies. [Like a wife: bibhr.ta_m = ra_ja_nam dha_rayeta_m; or, dha_rayata_m samam, support the arrow; samaneva yos.a_ (a singular used for the dual), the two extremities drawing close to the archer, like two women to their lover, stiyau yatha_ ka_ntam a_gacchatah].

The warrior is well-protected with armour of black leather plates; is well-armed with bow, quiver and arrows; rides a chariot and roars.

marma_n.i te varman.a_ cha_daya_mi somastva_ raja_mutena_tu vasta_ma
urorvari_ya_ varun.aste kr.n.out jayantam tya_nu deva_ madantu
yo nah svo aran.o yas’ca nis.t.yo jigha_msati
deva_ste sarve ghu_rvantu br.mha varma mama_ntaram

6.075.18 I cover your vital parts with armour; may the royal Soma invest you with ambrosia; may Varun.a amplify your ample felicity; may the gods rejoice (at beholding you) triumphant. [May Varun.a amplify: uror vari_yo varun.as te kr.n.otu, may Varun.a make the increase of the large; that is, sukham, happiness].

6.075.19 Whoever, whether an unfriendly relative or a stranger, desires to kill us, may all the gods destroy him; prayer is my best armour. [Sa_maveda: brahma varma mama_ntaram, s'arma varma mama_ntaram, my best happiness my armour].

The king was to be a wielder of a terrible bow and a good commander. [E. Hopkins, Position of the Ruling caste in Ancient India, *Journal of American Oriental Society*, XIII, p. 57; PC Chakravarti, 1942, *Art of War in Ancient India*, Delhi, pp. 150-180; VRR Dikshitar, *War in Ancient India*; Ram Gopal, *India of Vedic Kalpasutras*, p. 184 ff.; Apte, *Social and Religious life in Grhyasutras*, Bombay, 1954, p. 50 ff.; S.A. Dange, Aspects of war from the R.gveda, *Journal of Indian History*, Vol. XLIV, Part I (April 1966), Sl. No. 133, pp. 125-139].

Rudra is the preceptor of the science of archery. He is eulogized as a warrior.

अ॒स्माके॑भिः सत्व॑भिः शूर॒ शूरै॑र् वी॒र्या॑ कृ॒धि॒ यानि॑ ते॒ कर्त्वा॑नि ।
ज्योग् अ॑भूव॒न्न् अनु॑धूपितासो ह॒त्वी तेषा॒म् आ भ॑रा नो॒ वसू॑नि ॥

[gr.tsamad (a_n:girasa s'aunahotra pas'ca_d) bha_rgava s'aunaka] 2.030.10 Achieve, hero, along with our valiant heroes, the exploits that are to be achieved by you; long have (our enemies) been inflated (with pride); slay them, and bring to us their treasures.

ऋ॒तज्ये॑न क्षि॒प्रेण॒ ब्रह्म॑ण॒स् पति॒र् यत्र॒ वष्टि॒ प्र तद् अ॑श्नोति॒ धन्व॑ना ।
तस्य॑ सा॒ध्वीर् इष॑वो॒ याभि॒र् अस्य॑ति नृ॒चक्ष॑सो दृ॒शये॒ कर्ण॑योनयः ॥

The r.s.i who adores Rudra in RV 2.30.10 exhorts in RV 2.24.8 that the country should abound in brave warriors well-versed in the science of archery to maintain peace and order. Yajurveda (16.29: namah kapardine ca vyuprakes’a_ya ca namah sahasra_ks.a_ya ca s’atadhanvane ca namo giris’aya_ya s’ipivis.t.a_ya ca namo modus.t.ama_ya ces.ukate ca; the verse is clear that the science of archery is an essential qualification of a king who is referred to as s’atdhanva (i.e. the holder of hundred kinds of bows). Terms such as is.u-dhanva (Bow and arrow), is.u-dhanvina (holder of bow

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and arrow), adhijya-dhanva (bow fitted with string) occur in Vedic texts (Taittiri_ya Sam.hita_ 5.2; Aitareya Bra_hman.a 7.19; 1.25; S.Br. 9.1; 1.6).

AV1.2.1:
vidya_ s'arasya pitaram parjanyam bhu_ridha_yasam
Vidmos.vasya ma_taram pr.thivi_m bhu_rivarpasam

AV 1.1.3
Ihaiva_bhi vi tanu_me a_rtni_ iva jyaya_
Va_caspatirni yacchata mat.ayeva_sta mayi s'r.tam

AV 1.19.2:
Vis.vavan~co asmaccharavah patanta ye asta_ ye ca_sya_h
Daivi_rmanus.yes.ava_ mama_mitra_na vi vidyata

AV 6.66.2:
A_tanva_na_ a_yacchantosyanta_ ye ca dha_vatha
Nirhasta_h s'atravah sthanendro vodya paras'ari_ta

AV 11.9.1:
Ye ba_havo ya_ is.avo dhavana_m vi_rya_n.i ca
Asi_n paras'u_na_yudham vitta_ku_tam ca yaddhr.di
Sarva tadarbude tvamamitrebhyo dr.s'e kuruda_ra_m.s'ca pradars'aya

Rudra as an archer is praised in AV 1.2.1: he protects all with his bow. In AV1.19.2, the arrows are implored: 'dispersing from us let the shafts fly, those that are hurled and that are to be hurled. Ye divine arrows of men pierce my enemies.' AV 11.9.1 provides a list of weapons to be used: bows and arrows, swords (asi), axes (kut.ha_ra), battle-axe (paras'u), spears. [**Goddara.** A Perso-Turkish sabre (Wallace Orient; GC Stone, p. 248; **Guddara.** An Indian sabre with straight quillons, a pistol hilt and a back-edged blade that widens towards the point (GC Stone, p. 254).].

2.024.08 Whatever Brahman.aspati aims at with the truth-strung quick-darting bow, that (mark) he surely attains; holy are its arrows with which he shoots (intended) for the eyes of men, and having their abode in the ear. [For the eyes of men: nr.caks.asah karn.ayonayah: the arrows are oblations and mantras; the first is obvious to the sight; the second is addressed to the ears of men].

भद्रम् मनः कृणुष्व वृत्रतूर्ये येना समत्सु सासहः ।
अव स्थिरा तनुहि भूरि शर्धतां वनेमा ते अभिष्टिभिः ॥

(sobhari ka_n.va) 8.019.20 Give us that resolute mind in conflict by which you conquer in combats; humble the many firm (resolves) of our foes; may we propitiate you by our sacrifices. [In conflict: vr.tratu_rye, in conflict, san:gra_me; or, pa_pana_s'a_ya (*Yajus.* 15,39), for the exptirpation of sin; ava sthira_ tanuhi = make the strong bows without bowstrings, sthira_n.i dhanum.s.i jya_rahita_ni kuru].

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जाम्य् अतीतपे धनुर् वयोधा अरुहद् वनम् ।
दृषदं जिह्वयावधीत् ॥

haryata pra_ga_tha 8.072.04 (Agni), the giver of food, scorches the vast bow (Of the sky); he mounts the water; he smites the cloud with his tongue. [With his tongue: ja_mi = pravr.ddham, sarvam atiricya vartama_nam; his own; may be a reference to a forest conflagration; he mounts the forest, he smites the rock (dr.s.adam) with his tongue].

इषुर् न धन्वन् प्रति धीयते मतिर् वत्सो न मातुर् उप सज्यूर् ऊधनि ।
उरुधारेव दुहे अग्र आयत्य् अस्य व्रतेष्व् अपि सोम इष्यते ॥

(hiran.yastu_pa a_n:girasa)9.069.01 (Our) praise is attached (to Indra) as an arrow to the bow; (the Soma-juice) is let loose to (Indra) the fosterer as a calf to the udder to its mother; (Indra sheds blessings) as a cow having a copious stream of milk yields it when coming into the presence (of the calf); in Indra's sacrifices the Soma is stimulated. [The fosterer: u_dhani = Indra, because he is the nourisher of everything].

During cremation, an arrow was first placed in the right hand of the dead warrior and then removed as the final act of the funeral ceremony; the arrow is burnt together with the body. (RV 10.18.9).

धनुर् हस्ताद् आददानो मृतस्यास्मे क्षत्राय वर्चसे बलाय ।
अत्रैव त्वम् इह वयं सुवीरा विश्वा स्पृधो अभिमातीर् जयेम ॥
(sam.kusuka ya_ma_yana; devata_ pitr.medha) 10.018.09 Taking his bow from the hand of the dead man, for the sake of our vigour, energy and strength, (I say) you are there; may we (who are) here, blessed with male offspring, overcome all the enemies who assail us.

अहं रुद्राय धनुर् आ तनोमि ब्रह्मद्विषे शरवे हन्तवा उ ।
अहं जनाय समदं कृणोम्य् अहं द्यावापृथिवी आ विवेश ॥
(va_ga_mbhr.n.i) 10.125.06 I bend the bow of Rudra, to slay the destructive enemy of the Bra_hman.as, I wage war with (hostile) men. I pervade heaven and earth.

Yajurveda (16.10) is also emphatic about the bow in the hands of Sena_pati: ‘So long as thy bow is fitted with the string, you will never be defeated and your country will always be prosperous:

vijyandhanuh mapardino vis’alyo ba_n.arva_ uta
Anes’annasya ya_ is.ava amusya nis.an:gadhih).

YV 19.39 praises the bow as the weapon which ensures victory:

dhanvana_ ga_ dhanvana_ji jayema dhanvana_ ti_vra_h samado jayema
dhanuh s’atrorapaka_mam kr.n.oti dhanvana_ sarva_h pradis’o jayema

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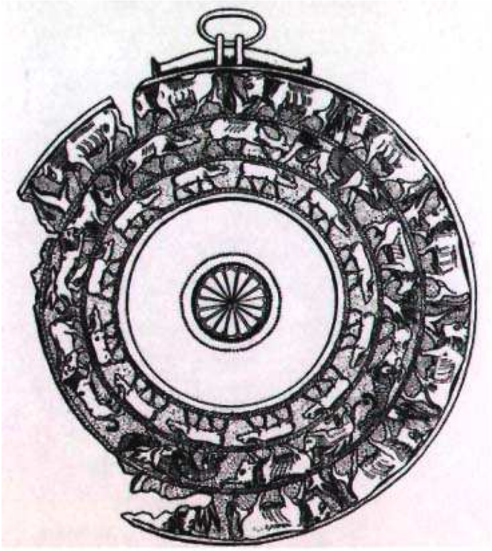
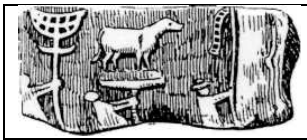
Artani is the nock or notch to which the bowstring is attached. (RV 1.51.8; 1.130.8; 1.156.5; 5.75.4). Bowstring is jya_ (RV 5.15.14), the sound of a bowstring or twang is jyaghos.a (RV 6.75.3); stringing of a bow is alan (RV 10.166.3); knocking the arrow to the string is pratidha (RV 4.27.3; 6.75.3; 10.51.6); to bend a bow is ayam and shooting a shaft is as (RV 4.27.3; 6.75.3; 10.51.6). Hastaghna is lit. protection for the hand or a wrist-guard (RV 6.75.14; Nirukta 9.14). It is called talatra in MBh. (Vanaparva 37.19; Dron.aparva 125.16: kavaci_ satalatra_n.i_ baddha gotha_n:gulivava_nuh) In the medieval period, the leather sleeve worn on the left arm was called godha or godhu (Egerton, p. 114).[RV 6.75.3: 'Close to his ear, as fain to speak, she presses, holding her well loved friend in her embraces. Strained on the bow she whispers like a woman, this bowstring that preserves us in combat'.] godha_ = a leather bracer worn by bowman [After GN Pant, 1997, p. 111].



Procession of animals

Bronze dish found by Layard at Nimrud: circular objects are decorated by consecutive chains of animals following each other round in a circle. A similar theme occurs on the famous silver vase of Entemena. In the innermost circle, a troop of gazelles (similar to the ones depicted on cylinder seals) march along in file; the middle register has a variety of animals, all marching in the same direction as the gazelles. A one-horned bull, a winged griffin, an ibex and a gazelle, are followed by two bulls who are being attacked by lions, and a griffin, a one-horned bull, and a gazelle, who are all respectively being attacked by leopards. In the outermost zone there is a stately procession of realistically conceived one-horned bulls marching in the opposite direction to the animals parading in the two inner circles. The dish has a handle. (Percy S.P.Handcock, 1912, Mesopotamian Archaeology, London, Macmillan and Co., p. 256).



Sealing. Mohenjo-daro. Portable standards in a procession (Marshall, 93, III: pl. 6, no.8).

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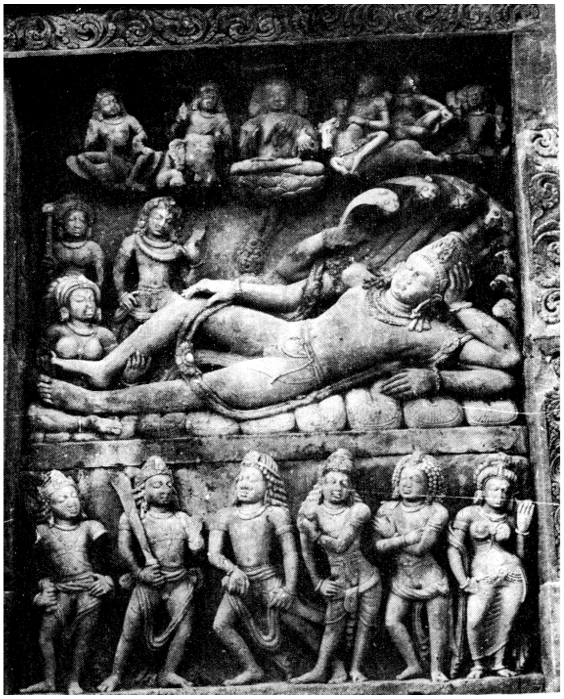

Deogarh. UP. ca. 500 AD. Anantas'a_yi with a_yudhapurus.a (After Fig. 24 in: V.R. Mani, 985, *The cult of weapons -- the iconography of A_yudha Purus.as*, Delhi, Agam Kala Prakashan)

Ma_rkan.d.eya P. refers to the presence near Vis.n.u of five personified forms of weapons: **pa_n~cajanya, sudars'ana, nandaka, kaumodaki_** and **sa_rn:ga** (the **conch, discus, sword, mace** and **bow**). Vaikha_nasa_gama and Vima_na_rcanakalpa refer to yogas'ayana, bhogas'ayana, vi_ras'ayana and A_bhica_rikas'ayana forms of Anantas'a_yi form. Five weapons are stipulated for the first three forms; the fourth form represented in the sculptural complex of Maha_balipuram does not contain any representation of a_yudhapurus.a-s. Anantas'a_yi forms are also associated with other images of Ma_rkan.d.eya, Bhr.gu, Agni, Garud.a, Brahma, Varun.a, Bhu_devi, S'ri_devi, S'iva, Daks.a, Na_rada, Tumbu_ru, the seven r.s.is, the twin As'vin-s, Sanaka_di Yogi-s, Su_rya, Candra, the demons Madhu and Kait.abha. (K.V. Sundararajan, 'The Typology of Anantas'a_yi icon', *Artibus Asiae,* Vol. XXIX, pp. 67-82).

San:gam literature in Tamil refers to the cakra as *ne_mi* or *tikiri*; the divinity is known as ne_miya_n- and tigiriya_n-. (*Kalittokai*, V, 104, 19, 9, 78; *Akam*, V, 178, 11, 14-15; *Padir-r-uppattu*, V, 31, 1,9; *Nar-r-in.ai,* invocation). *Man.imekalai, Paripa_t.al* and *Mullaippa_t.t.u* refer to cakra with shining rays and golden lustre in the right hand and s'an:kha in the left hand. (*Man.ime_kalai*, XIII,1,37; *Paripa_t.al* V, 1: 11,49-54, V,3,1,88 etc.; *Mullaippa_t.t.u* 11,1-2; loc.cit., Mani, p. 7). Paripa_t.al (V,15,1.55) also refers to other weapons: valampuri (s'ankha), ne_mi (cakra), s'ilai-ampu (bow and arrow -- sa_ran:ga), pa_ra_valai, va_l. (sword-- khad.ga), tan.t.u (gada)) and na_n~cil (ploughshare -- hala); the five weapons of Vis.n.u were the motifs used in the ornament called aimpat.aitta_li worn by children in Tamil Nadu in early times. (R. Champakalakshmi, Vais.n.ava Iconography in the Tamil Country, p. 51, fn. 27).

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Badami. Karnataka. ca. 575 AD. Anantas'a_yi with a_yudhapurus.a (After Fig. 23 in: V.R. Mani, 1985, *The cult of weapons -- the iconography of A_yudha Purus.as*, Delhi, Agam Kala Prakashan)

'Like the weapons of Vis.n.u those of S'iva, and other S'aiva deities like tris'u_la, paras'u, vajra, s'akti, dan.d.a, khad.ga, pa_s'a, an:kus'a, dhvaja etc. are described in the s'ilpa texts as befitting personification. Iconographic details regarding concretised images of these weapons are found in the *Uttaraka_mika_gama, Vis.n.udharmottara, Pu_rvakarn.a_gama* etc...the **heti**, which according to Gopinatha Rao is a weapon like a hatchet, should be shown as a female. The other a_yudhas to be personified as a male are the **bhindi**, the sling with which stones are thrown and the **ba_n.a** which should have a red body and beautiful eyes...the metaphysical meaning conveyed through the different a_yudhas have been explained in the Ka_mika_gama and a few S'aiva A_gamas. It is said that "the **tris'u_la** indicates the three gun.as of prakr.ti respectively called satva, rajas and tamas. The **paras'u** represents S'iva's divine strength and power (**s'akti**); the **khad.ga** his valour; **va_hni (**fire) his sam.ha_ra s'akti or power of destruction; this last one, namely, the va_hni is further conceived to destroy all **pa_s'a**s or bonds and attachments, and is consequently emblematic of the enlightenment which comes after the bonds of sin and sorrow are broken asunder and destroyed. The **na_ga**s serving as ornaments on his body show the fortitude of S'iva as also the inviolability of vidhi, or his commandments and laws. The pa_s'a which is a three-fold cord or rope, indicates the three-fold bondage of incarnated life consisting of karma_, ma_ya_ and mala, that is, of work, delusion and impurity. The **ghan.t.a_** (bel) is the symbol of sound looked upon as the original cause of creation and is, indicative of the mantra-svaru_pa of S'iva which is his mystic sound-form. The **an:kus'a** stands for the selective faculty in choosing what is enjoyable for the atman as soul." (TA Gopinatha Rao, Elements of Hindu Iconography, Vol. I, Part I, pp. 293-94).' (VR Mani, p.29, pp. 39-40).

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	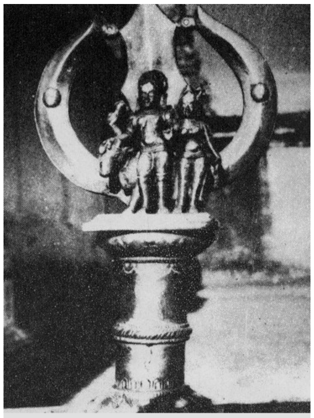	
Bharates'var (or s'atrughnes'war?) temple. Bhuvanes'war, Orissa. Door guardian, four-armed, depicted on a door jamb. Upper right arm touches the hood of a serpent issuing from the sarpakun.d.ala in his right ear; lower right hand rests on the weapon, tris'u_la personified as a standing dwarf. Over the head of the dwarf are three prongs of the tris'u_la; the lower part of the tris'u_la consisting of a stem pierces his head and throat and is shown in front of him; he holds it by his hands. (After Fig. 26 in: V.R. Mani, 985, *The cult of weapons -- the iconography of A_yudha Purus.as*, Delhi, Agam Kala Prakashan)	**Astradeva.** Tiruman.an~ceri, Mayuram taluk, Tanjore dist. On the tris'u_la, four-armed S'iva is with Uma_devi, both standing with the va_hana, bull. S'iva carries in his upper hands, an **axe** and an **antelope**; his lower right hand is placed on the head of the r.s.abha and lower right arm is stretched to the hip of Pa_rvati (Uma_). A representation of A_lin:gana r.s.abha_n.d.ika. (After Fig. 36 in: V.R. Mani, 1985, *The cult of weapons -- the iconography of A_yudha Purus.as*, Delhi, Agam Kala Prakashan) [Antelope as a weapon will be elaborated elsewhere on this website, in a separate section dealing with the pictograph of an antelope].	**Subrahman.ya shrine, Br.hadi_s'vara Temple**, Tanjore. Late Na_yaka period. Dwa_rapa_la with S'akti on the head and depicting vajra weapon of Subrahman.ya. (After Fig. 33 in: V.R. Mani, 1985, *The cult of weapons -- the iconography of A_yudha Purus.as*, Delhi, Agam Kala Prakashan). (After Fig. 7 in: V.R. Mani, 1985, *The cult of weapons -- the iconography of A_yudha Purus.as*, Delhi, Agam Kala Prakashan)

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Vis.n.u, Ghat.es'var temple. Baroli. The mu_rti carries in one of his upper right arm a cakra_yudha on top of which a human head is seen, an apparent symbol of personification of the a_yudhapurus.a. [**Cakra** is a vedic weapon.][7]

'The incidence of Cakrapurus.a in art starts from the fourth century onwards, one of the earliest specimens being a late Gandha_ra metal image of Vis.n.u with a charming Cakrapurus.a gazing at him (*Indologen Tagung*, Gottingen, W. Germany, 1959, pp. 165-178; *Indische Sculpturen*, vol. I, pl. 42-43; C. Sivaramamurthi, *Indian Bronzes*, p. 14, fig.2)...The image of Vis.n.u in the temple of Rajgir places its lower right arm on the shoulders of a male dwarf who has a 'wheel-halo' behind him revealing his identity as Cakrapurus.a (A. Ghosh, *A Guide to Rajgir*, 1944, pl. V fig. C; C. Sivaramamurti, 'The Weapons of Vis.n.u', *Artibus Asiae*, XVIII (2), 1955, p. 128, fig.1).' (VR Mani, p. 11). (After Fig. 2 in: V.R. Mani, 1985, *The cult of weapons -- the iconography of A_yudha Purus.as*, Delhi, Agam Kala Prakashan)

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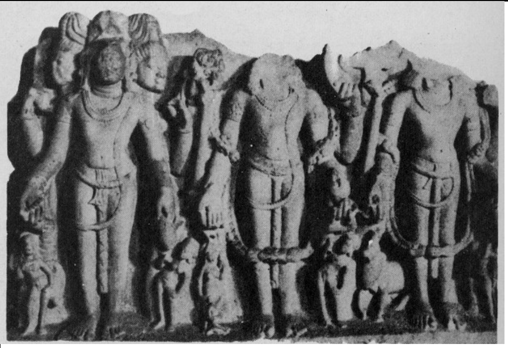
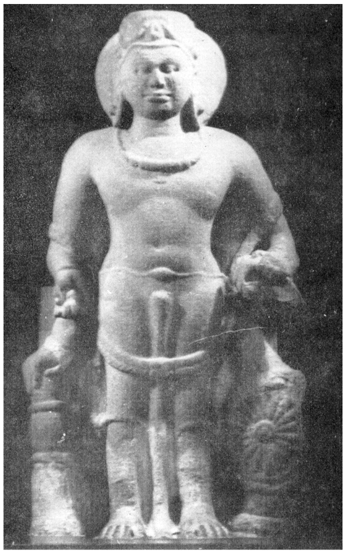


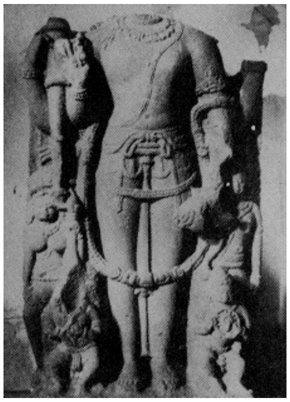
Gada_devi and Cakrapurus.a flank Vis.n.u in the Trimu_rti panel. Lucknow Museum. (After Fig. 3 in: V.R. Mani, 1985, *The cult of weapons* -- *the iconography of A_yudha Purus.as*, Delhi, Agam Kala Prakashan)

Udayagiri. Cave No. 6. Rock-cut Vis.n.u with Gada_devi and Cakrapurus.a. The latter is a dwarf to whose head (now broken) is attached the cakra with many spokes. Gada_devi is carved in the body of the gada_ held by a right hand of Vis.n.u (After Fig. 4 in: V.R. Mani, 1985, *The cult of weapons* -- *the iconography of A_yudha Purus.as*, Delhi, Agam Kala Prakashan)

Harihara with a_yudhapurus.a 5th or 6th cent. AD. Cakrapurus.a is on Vis.n.u's side and Tris'u_lapurus.a is on S'iva's side. Kutari. Allahabad dist. (Allahabad Museum). (After Fig. 5 in: V.R. Mani, 1985, *The cult of weapons* -- *the iconography of A_yudha Purus.as*, Delhi, Agam Kala Prakashan)



Vis.n.u with Cakra and Gada_. Lower pair of arms carries a gada_ and an 18-spoked cakra placed on a pedestal. Jhusi. Allahabad dist. (Allahabad Museum).



Terracotta plaque from Ranmahal (Bikaner Museum). '...the dwarfish Cakrapurus.a appears independently as a brahmaca_ri, putting on a dhoti reaching the knees; left hand placed on the thigh and right hand raised up as usual; a wheel halo has also been shown behind his head. This plaque must have been originally studded on the exterior of some early Gupta and brahmanical brick temple in the Bikaner region of ancient Sarasvati and Dr.s.advati_ rivers' (R.C. Agrawala, 'Chakra Purus.a in Early Indian Art', *Bharatiya Vidya*, Vol. XXIV, Nos. 1-4, 1964, p. 43. (After Fig. 6 in: V.R. Mani, 1985, *The cult of weapons* -- *the iconography of A_yudha Purus.as*, Delhi, Agam Kala Prakashan) **Junagarh (Junagarh Museum).** Two young dwarfs hold the weapons, one the conch and the other the discus. At the bck of the dwarf holding the conch is a female figure holding a padma with a long stalk, in her hand. Beside her forehead is suspended the gada_ of Vis.n.u from his right arm; she is perhaps the personififed Padma. (After Fig. 8 in: V.R. Mani, 1985, *The cult of weapons* -- *the iconography of A_yudha Purus.as*, Delhi, Agam Kala Prakashan).

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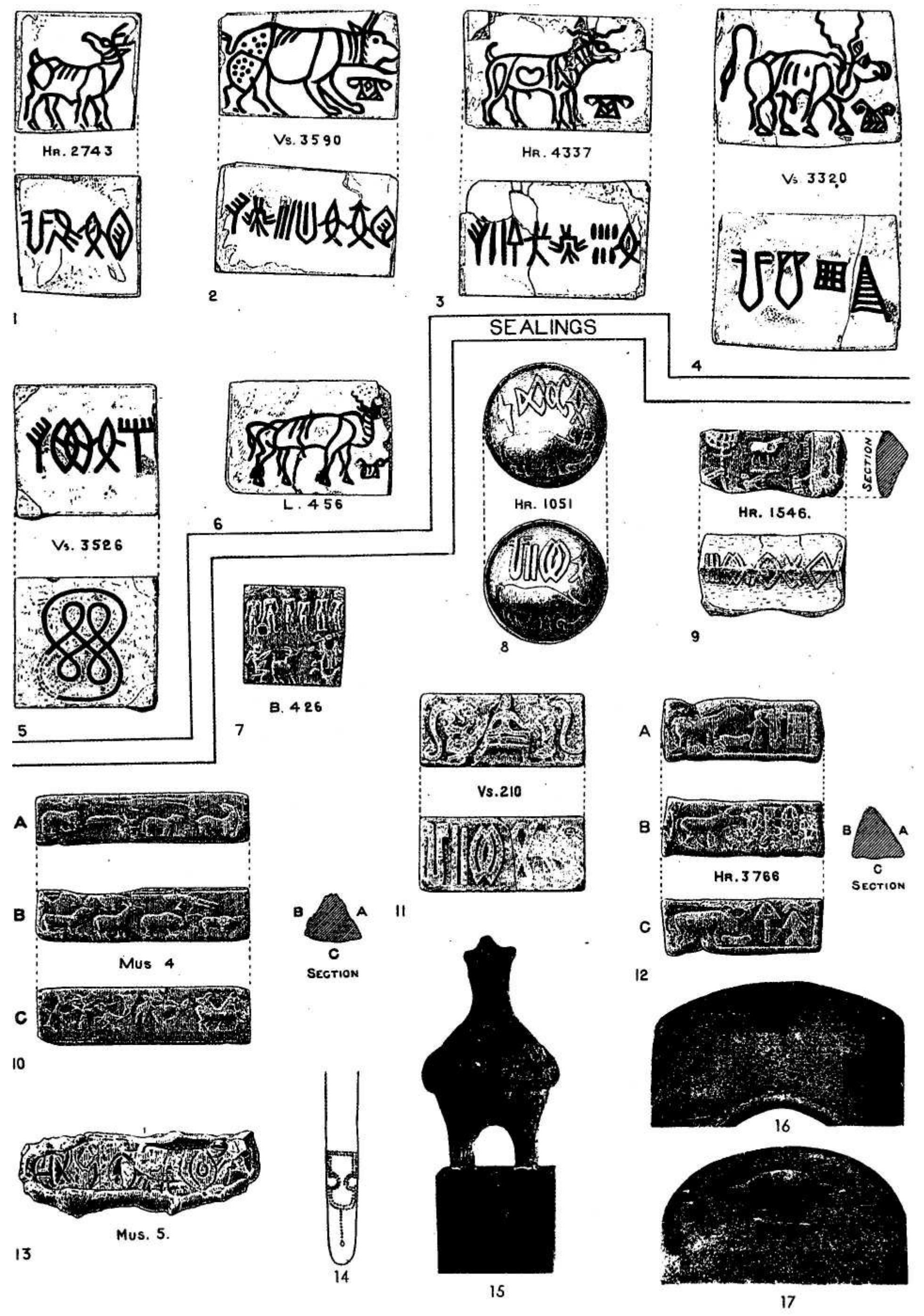

MIC, Pl. CXVIII. Copper tablets, sealings and miscellaneous objects. Item 14 is a gold fillet with an outline of the 'standard device'.

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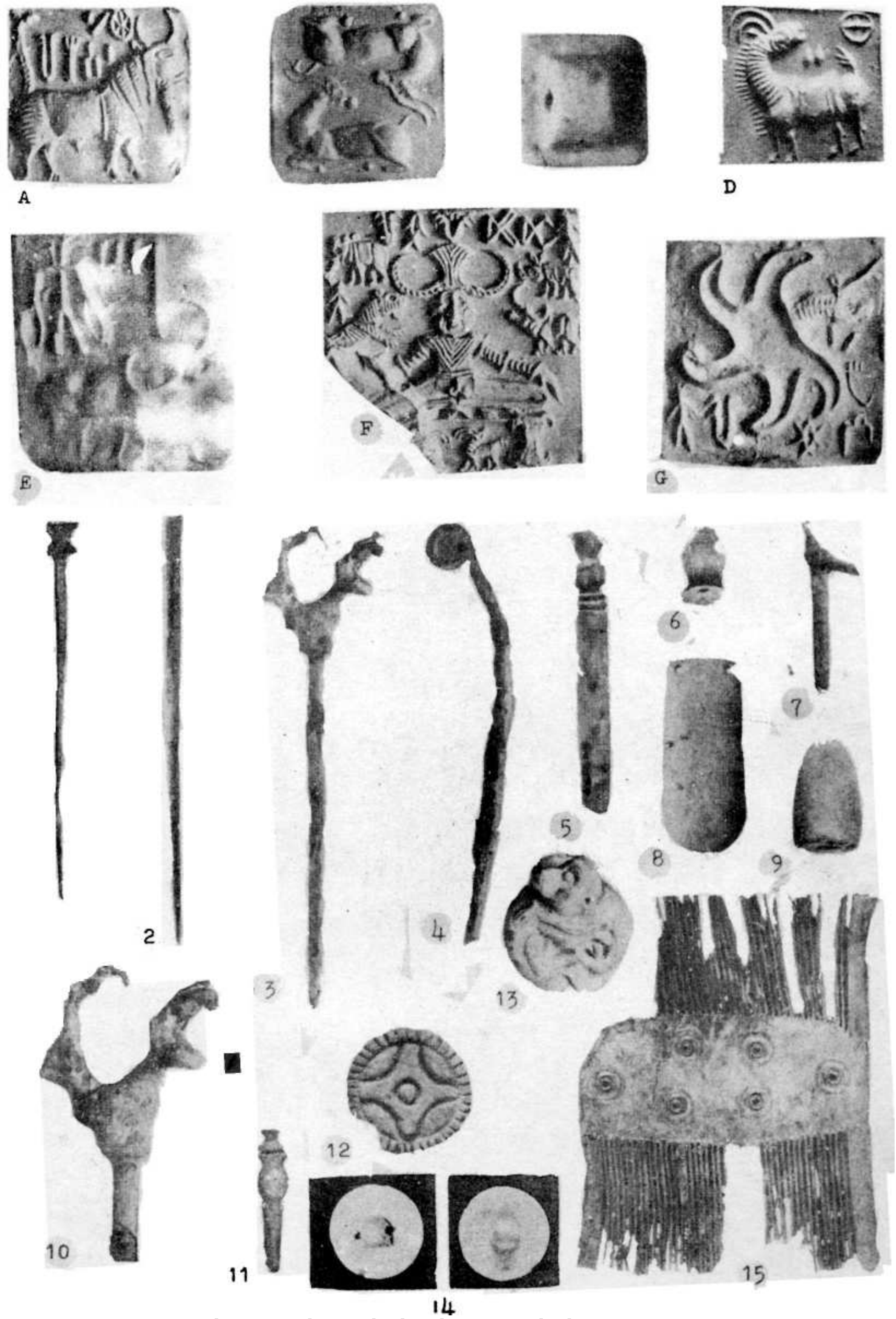

FEM. Pl. C. Seal impressions, hair-pins, comb, buttons, etc. Lower levels.

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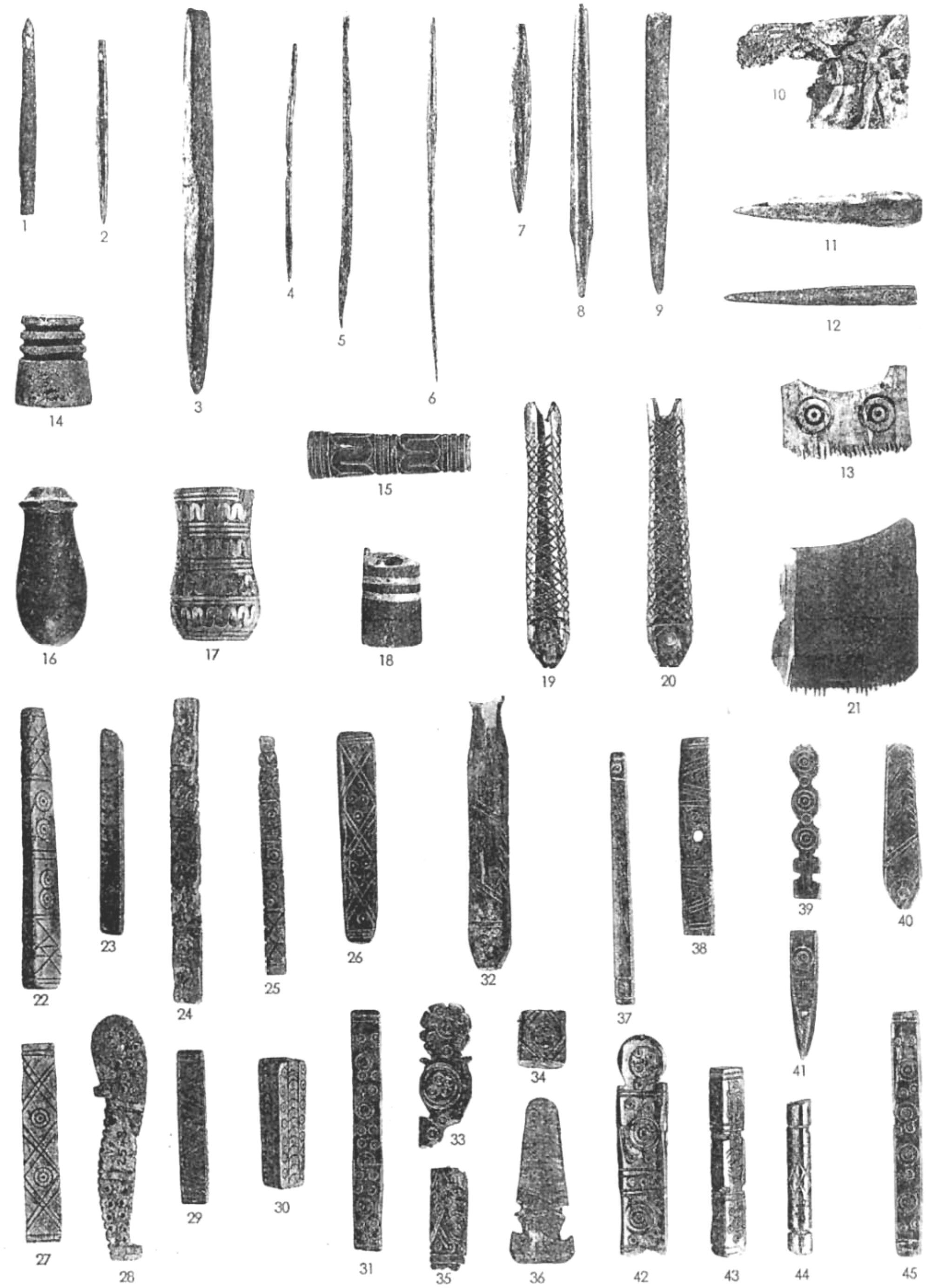

MIC, Pl. CXXXII. Needles, awls, handles and objects of ivory bone. Dotted circles on ivory (Items 13, 39, 42, 45). Item 10 has a warrior pictograph which becomes a sign.

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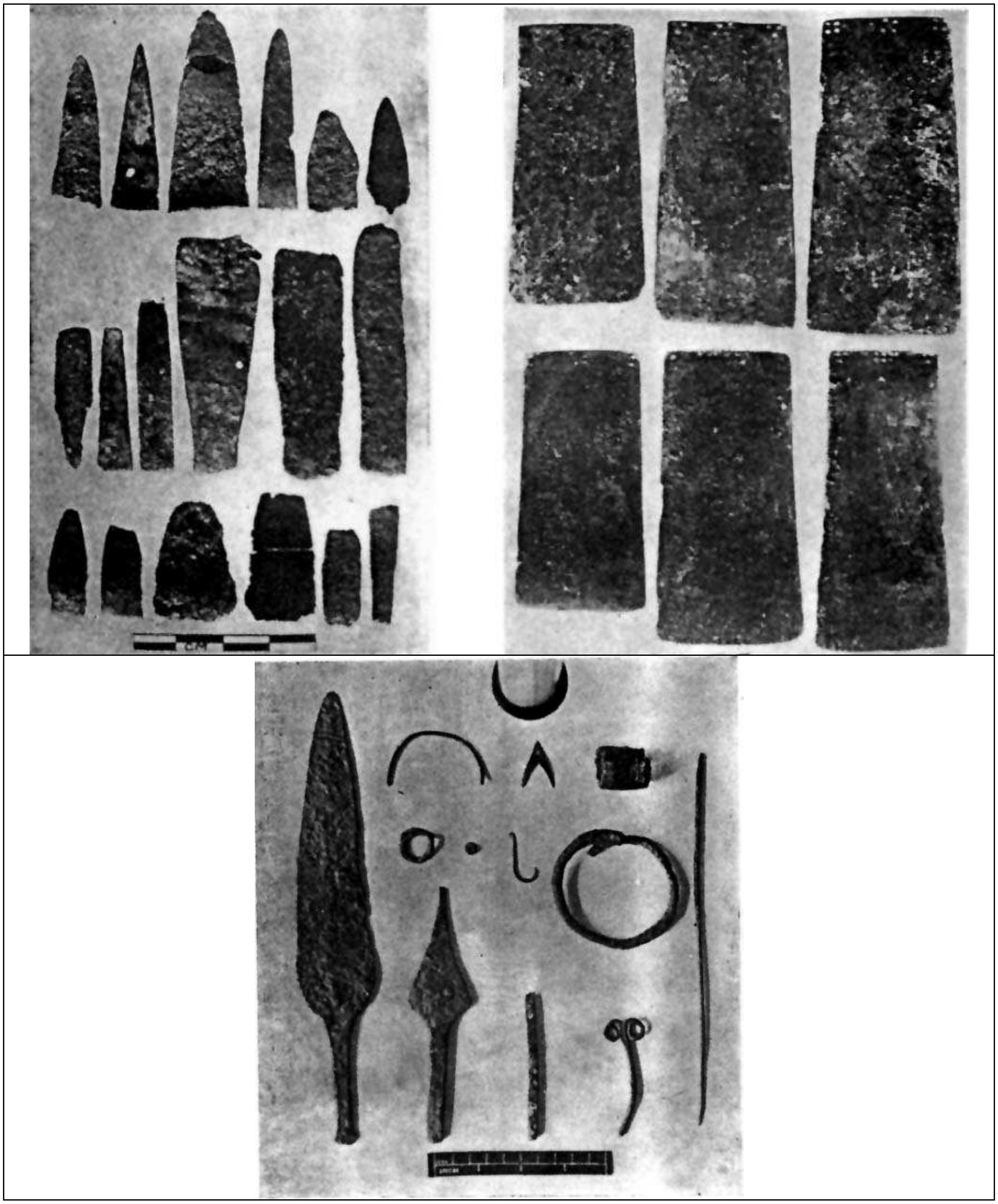

Banawali: Copper objects of the Harappan period. [After Pl. 59 in: BB Lal and SP Gupta, eds., *Frontiers of the Indus Civilization*].

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Ahar: copper choppers and a celt; Kurada (or Khurdi): copper celts, choppers and rings.

[After Pl. 69 and 70 in: BB Lal and SP Gupta, eds., *Frontiers of the Indus Civilization*].

Ganeshwar: coper arrowheads; copper implements; copper celts with indentations. [After Pl. 73, 74 and 76 in: BB Lal and SP Gupta, eds., *Frontiers of the Indus Civilization*].

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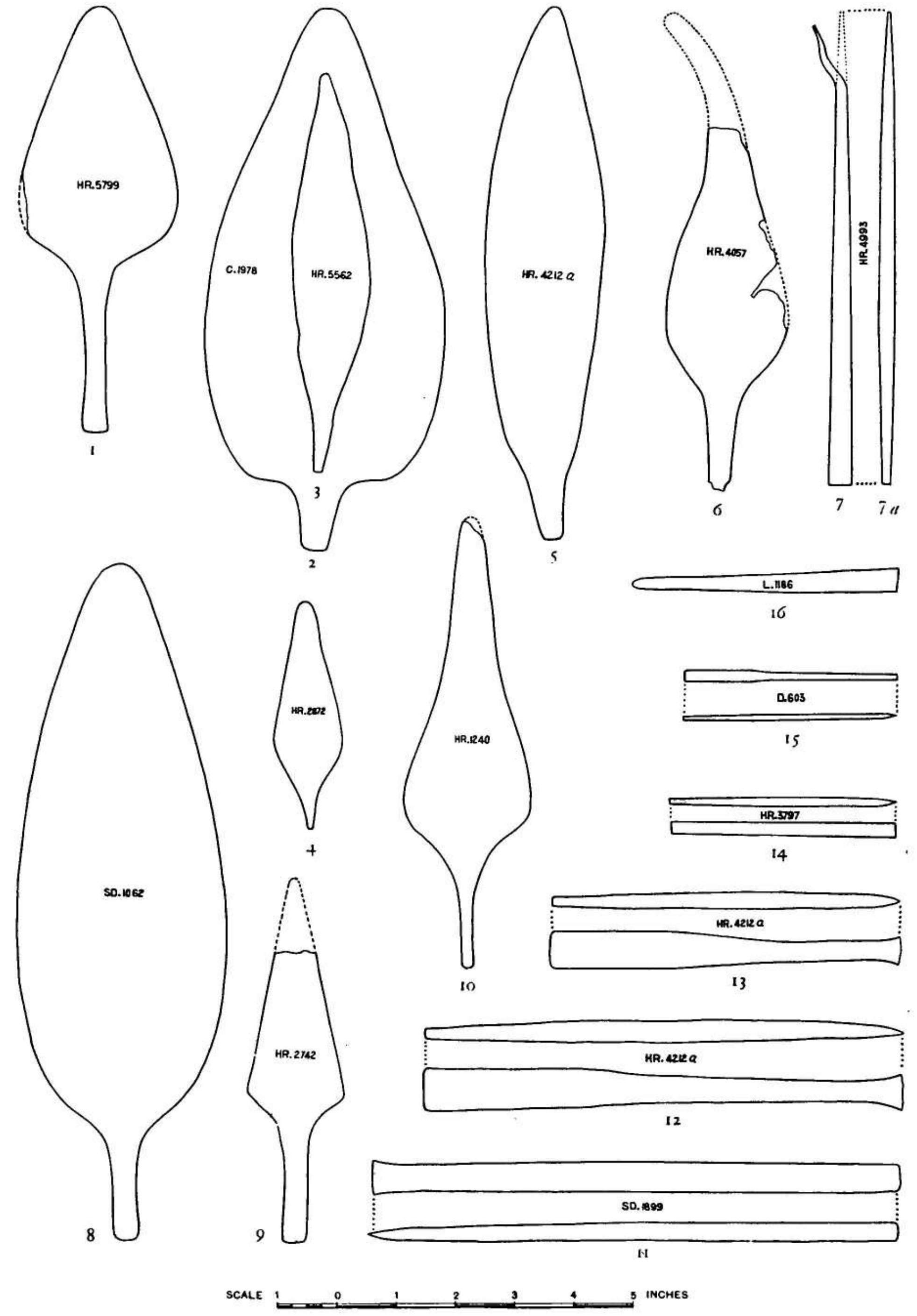

MIC, Pl. CXXXV. Copper and bronze tools and weapons.

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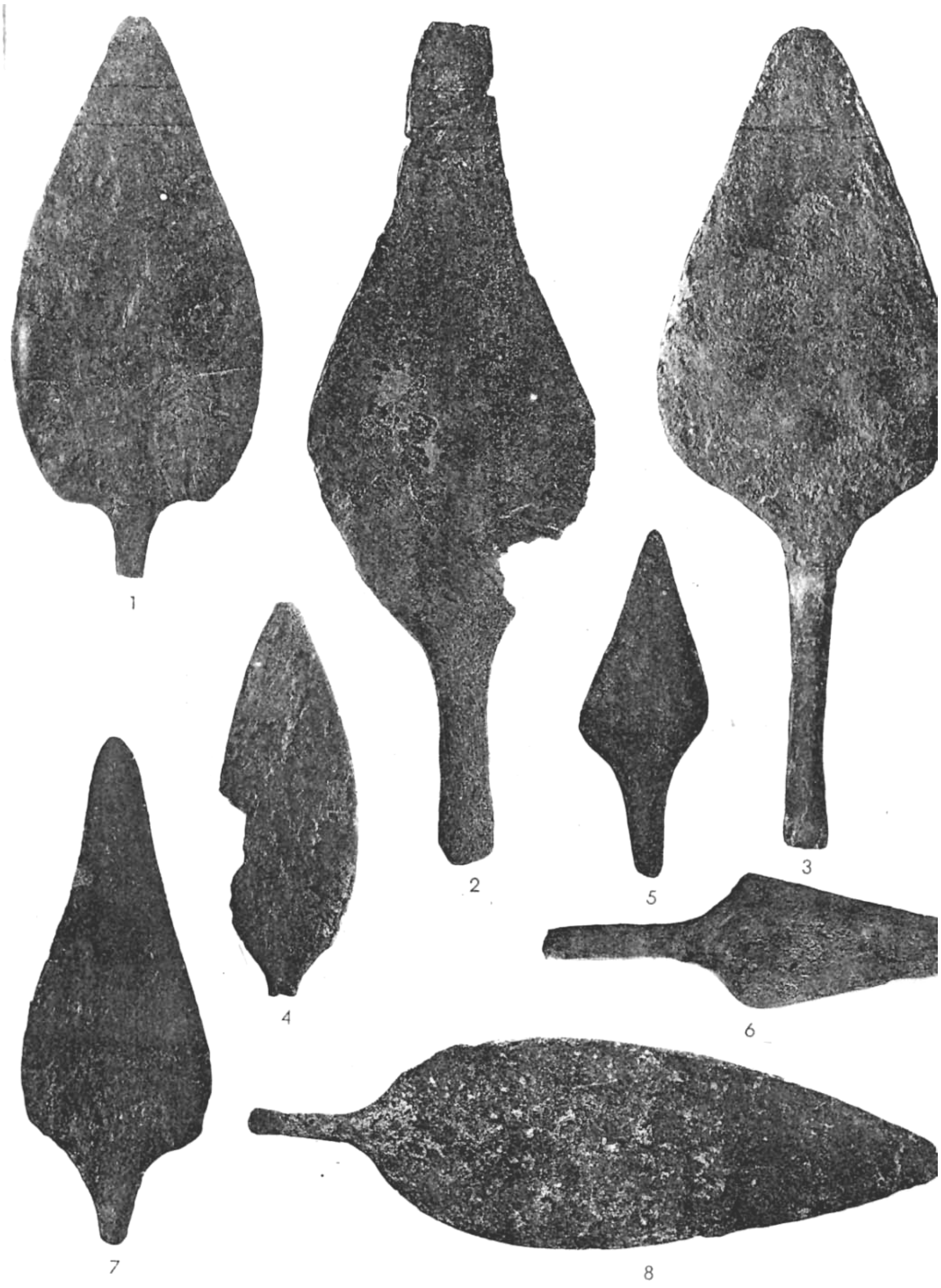

MIC, Pl. CXXXVI. Copper lance-heads or daggers

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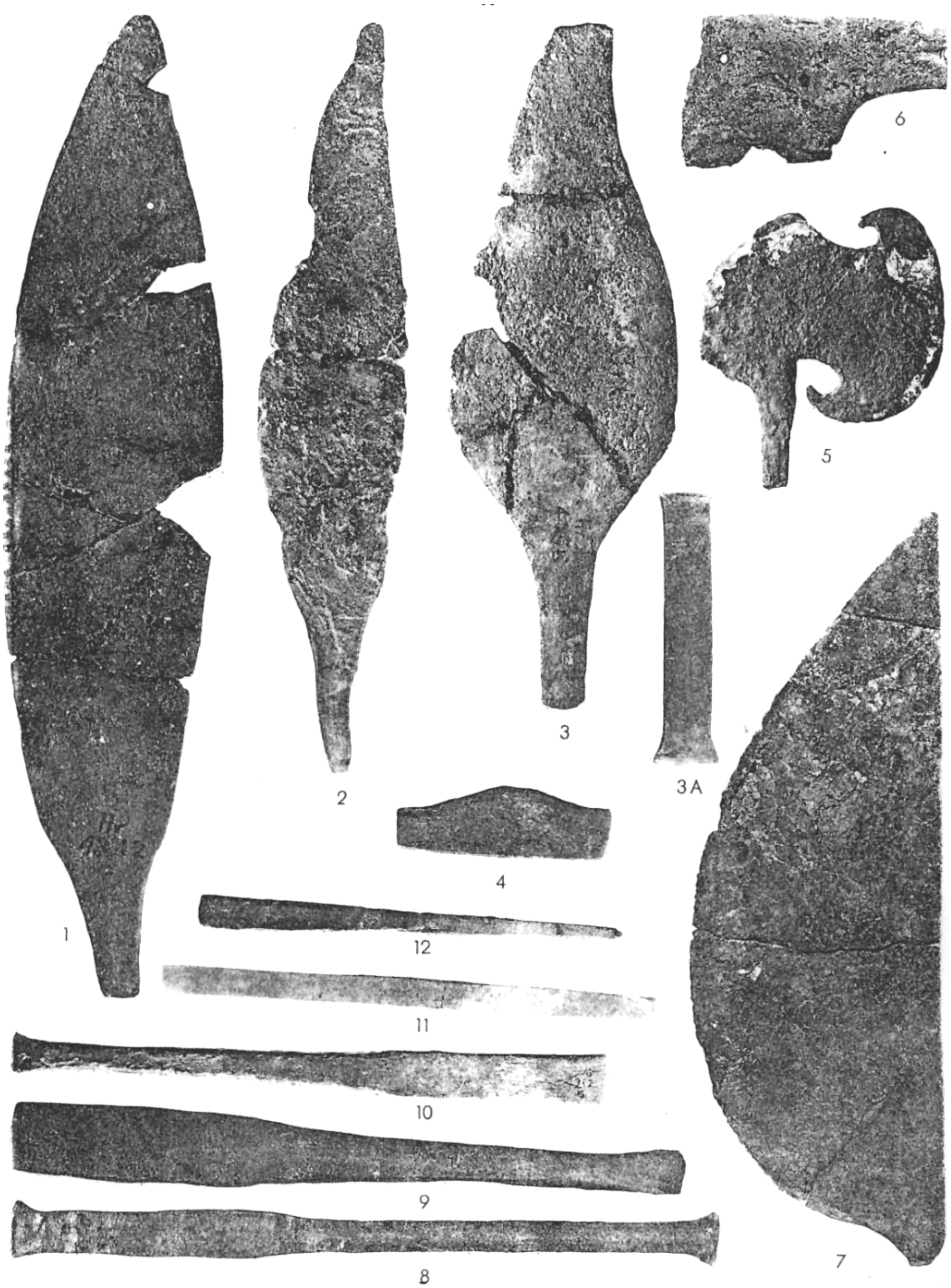

MIC, Pl. CXXXVII. Bronze and copper tools, etc.

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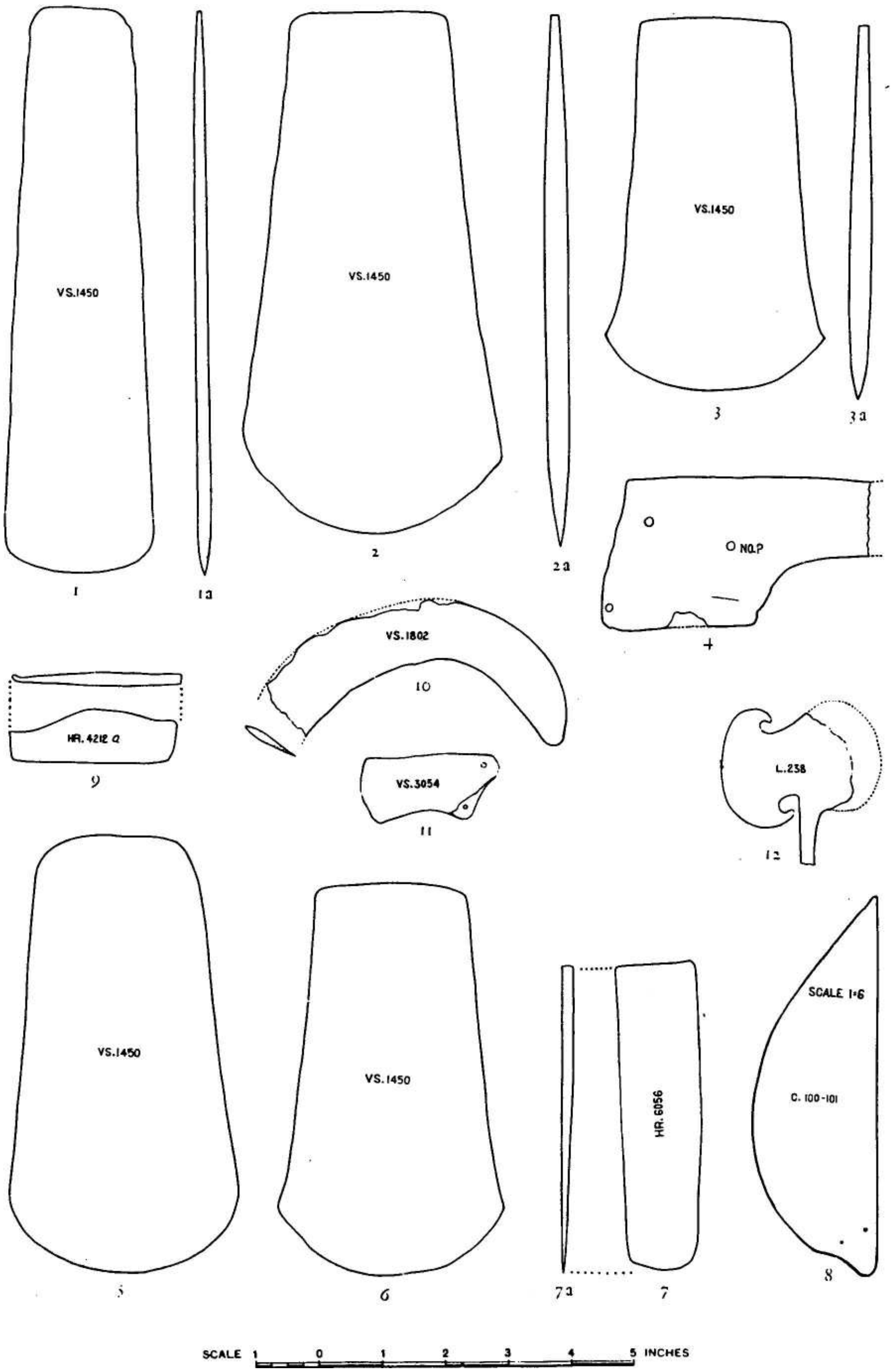

MIC, Pl. CXXXVIII. Copper and bronze tools and implements.

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MIC, Pl. CXXXIX. Copper and bronze tools etc.

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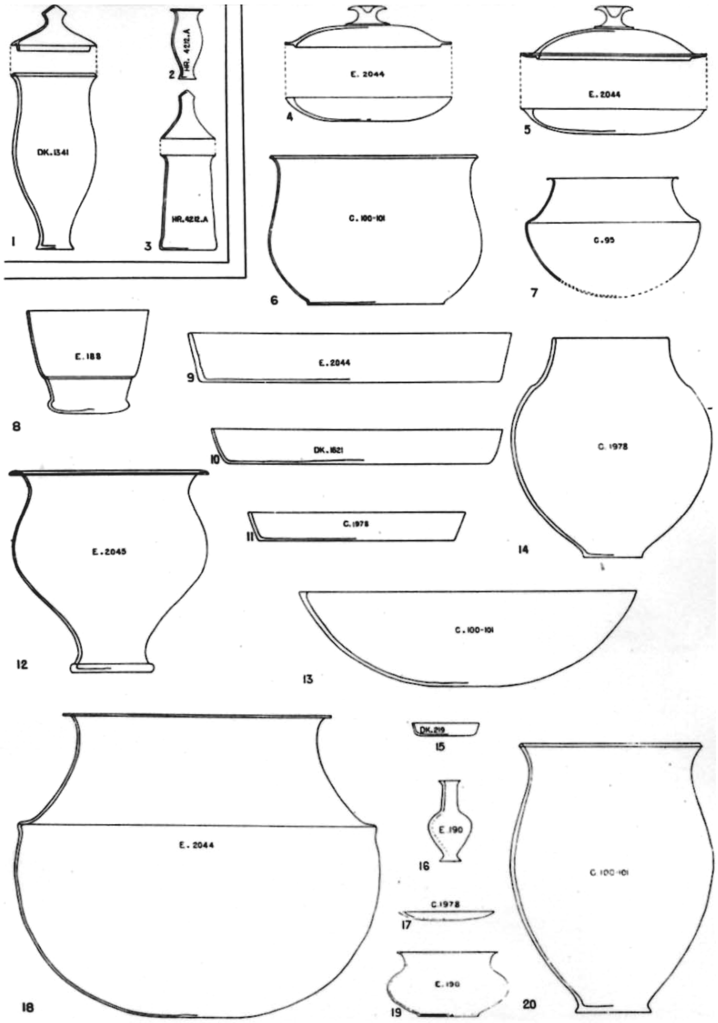

MIC, Pl. CXL. Items 1,2,3: Silver vessels. Others: Bronze and copper vessels.

Kurada: Copper bowls.

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MIC, Pl. CXLI. Copper and bronze vessels.

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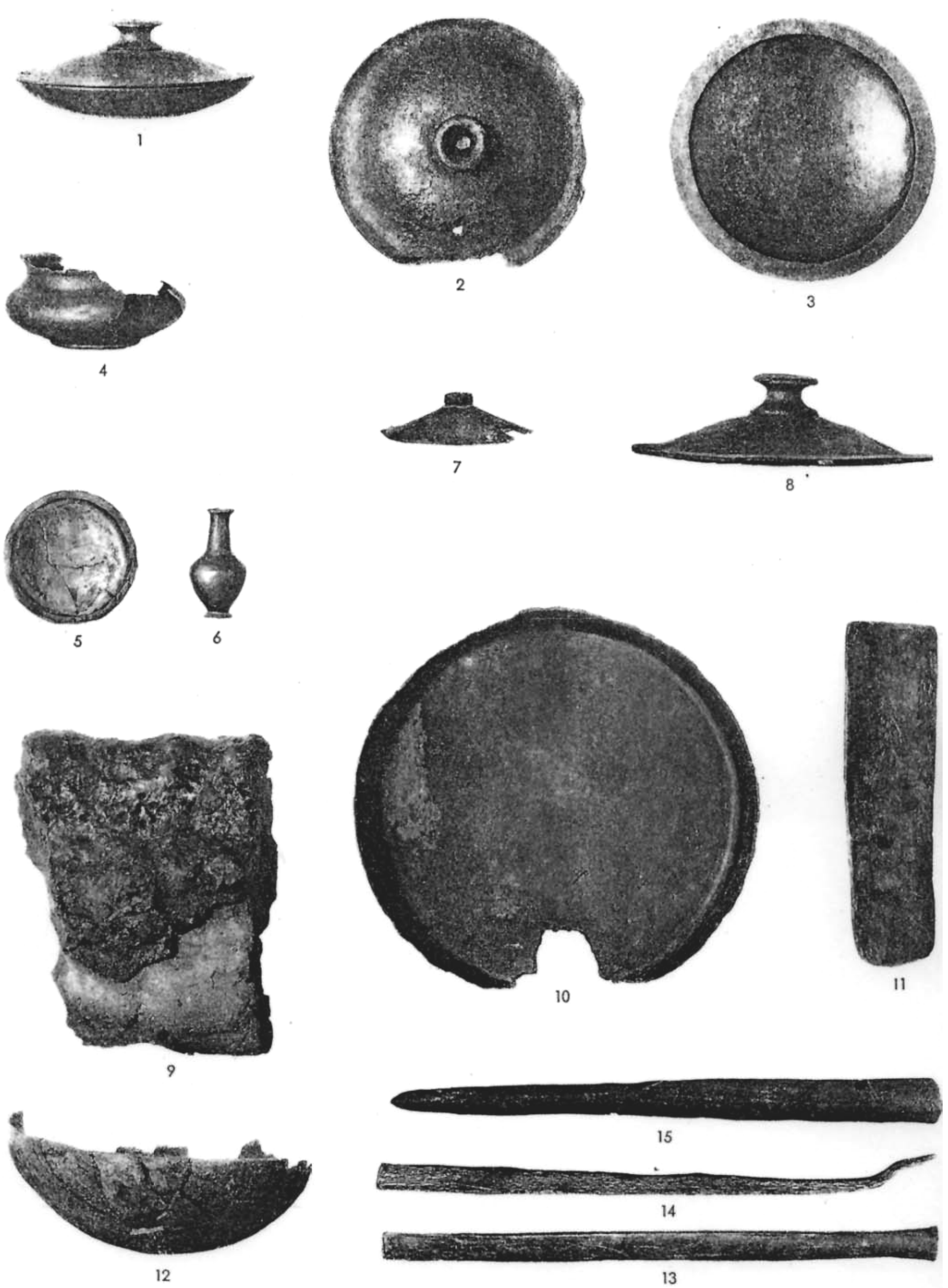

MIC, Pl. CXLII. Copper and bronze vessels and objects.

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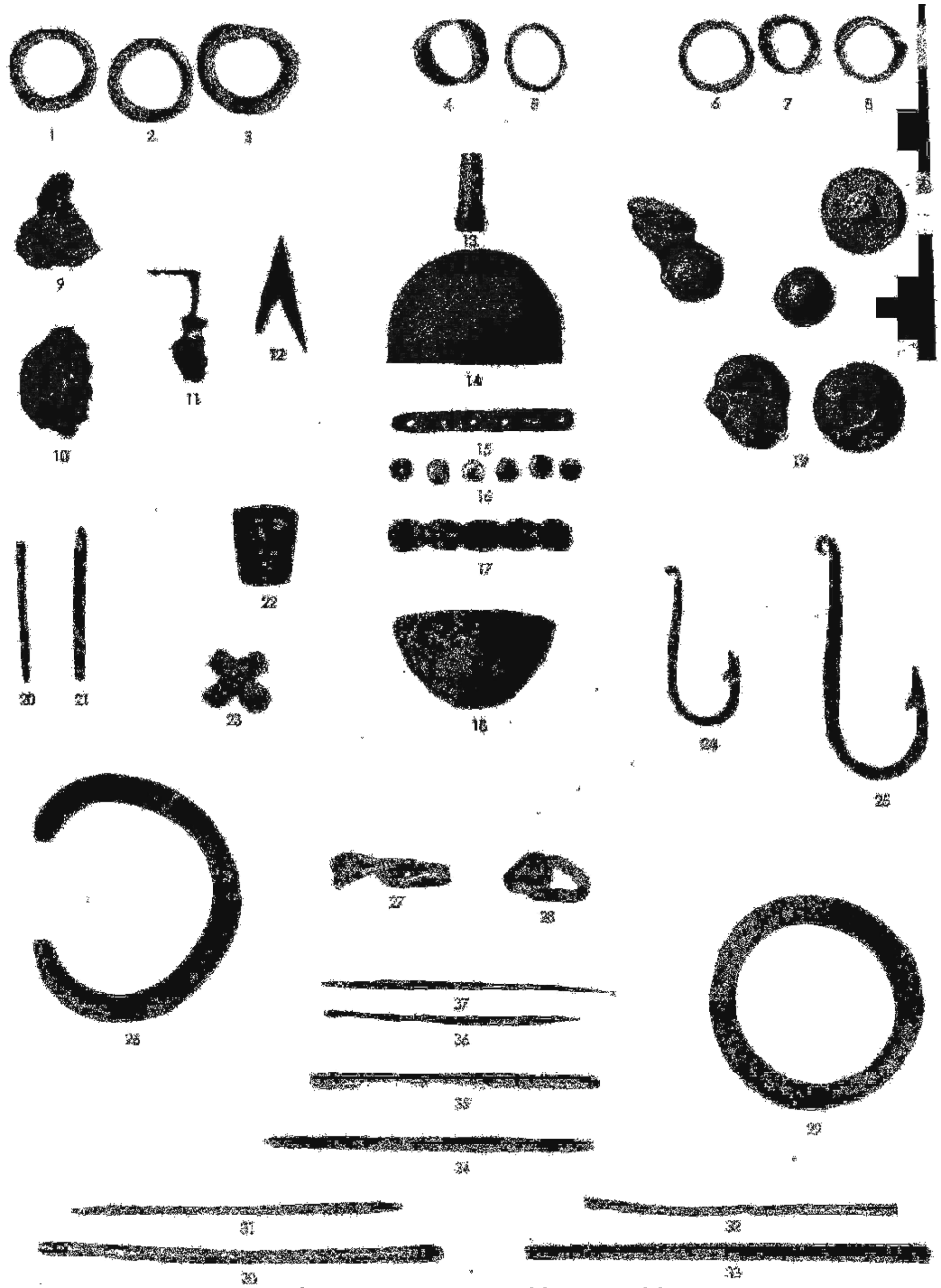

MIC, Pl. CXLIII. Copper and bronze objects.

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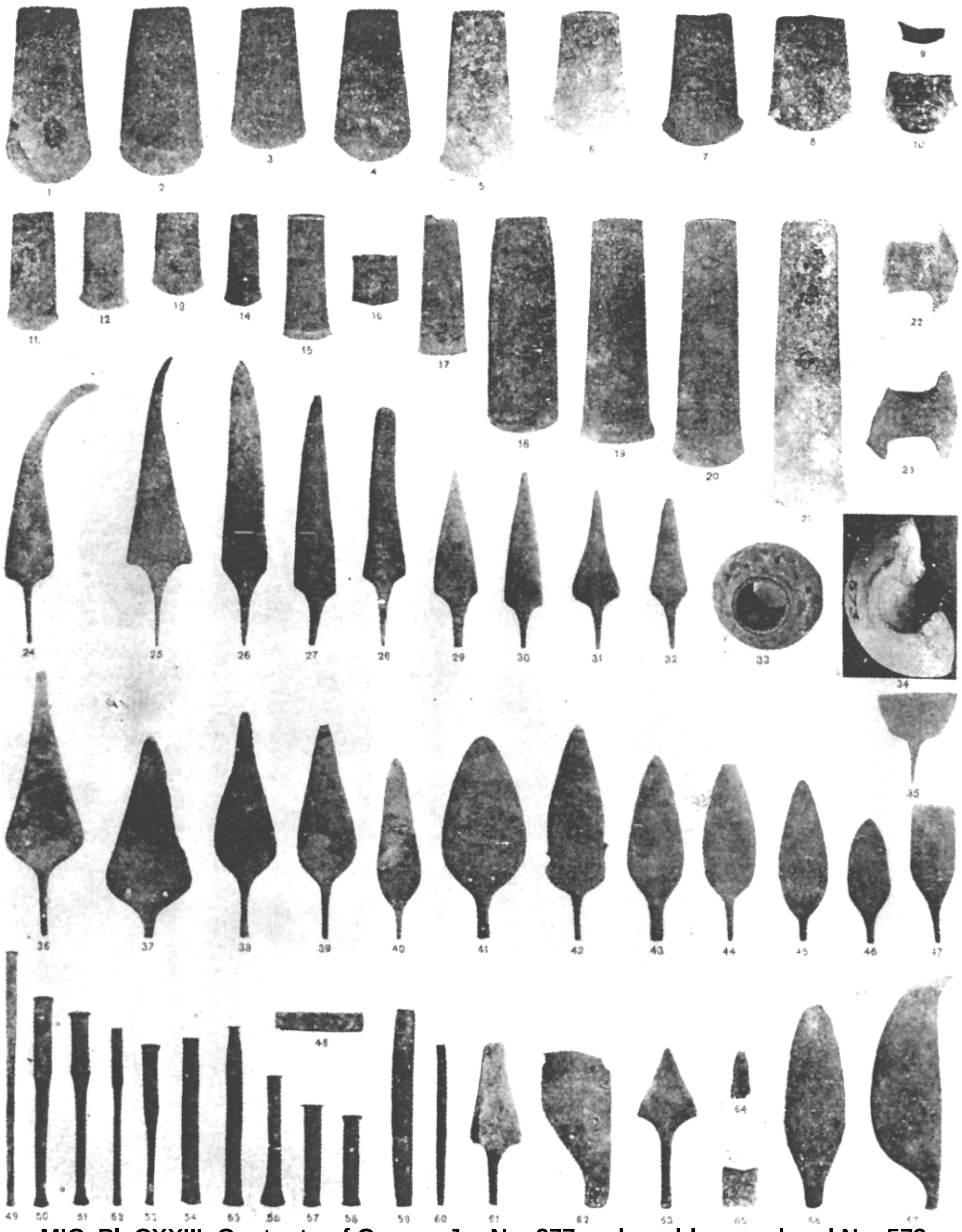

MIC, Pl. CXXIII. Contents of Copper Jar No. 277 and marble macehead No. 573.

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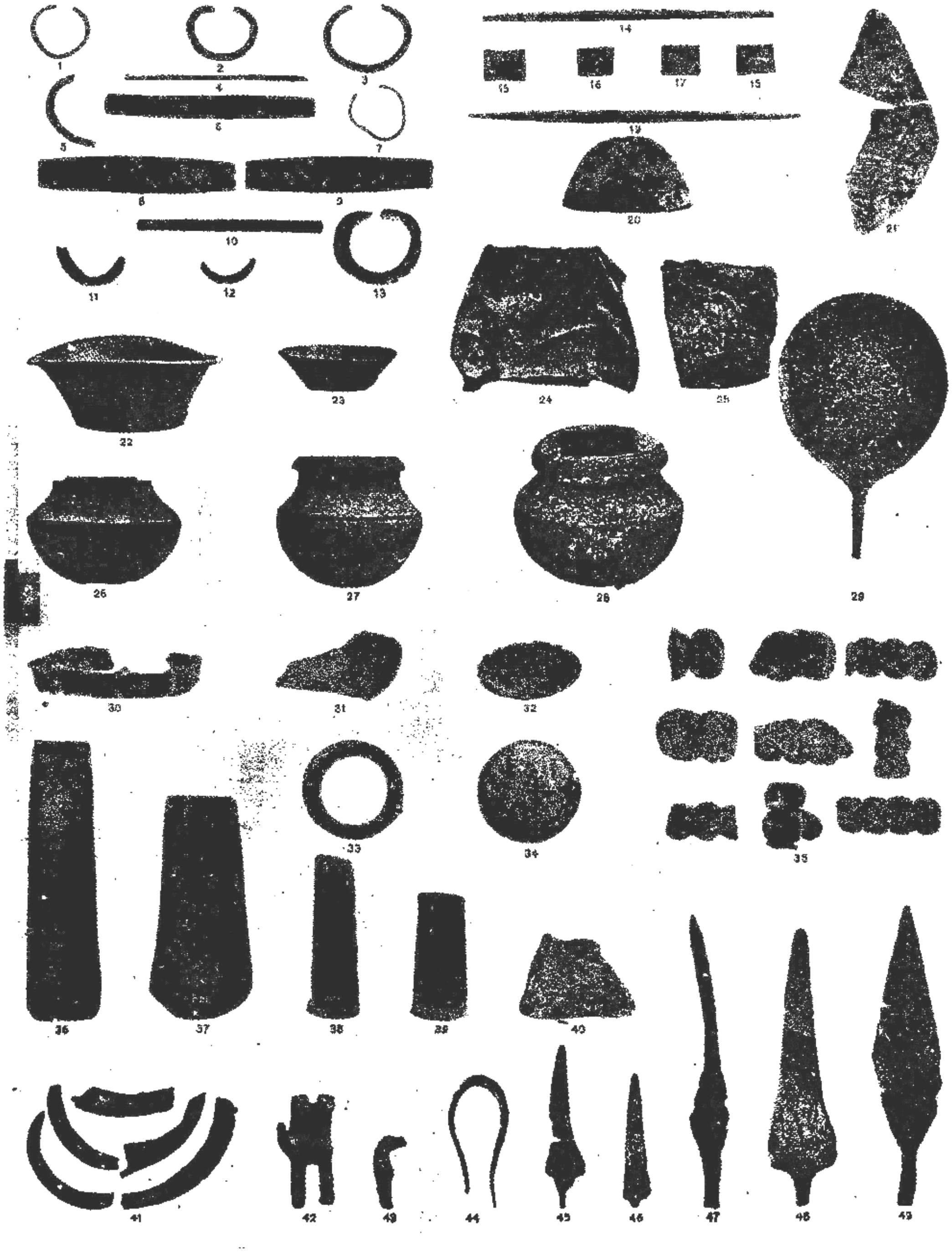

MIC, Pl. CXXIV. Copper and bronze ornaments, utensils, implements, weapons etc.

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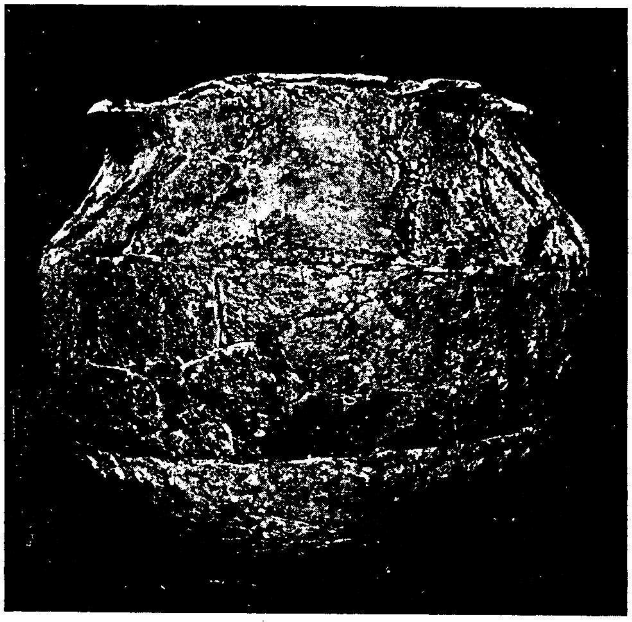

Lothal. Riveted copper jar. Comparable in shape to the jar found at Mohenjo-daro. [After SR Rao, 1985].

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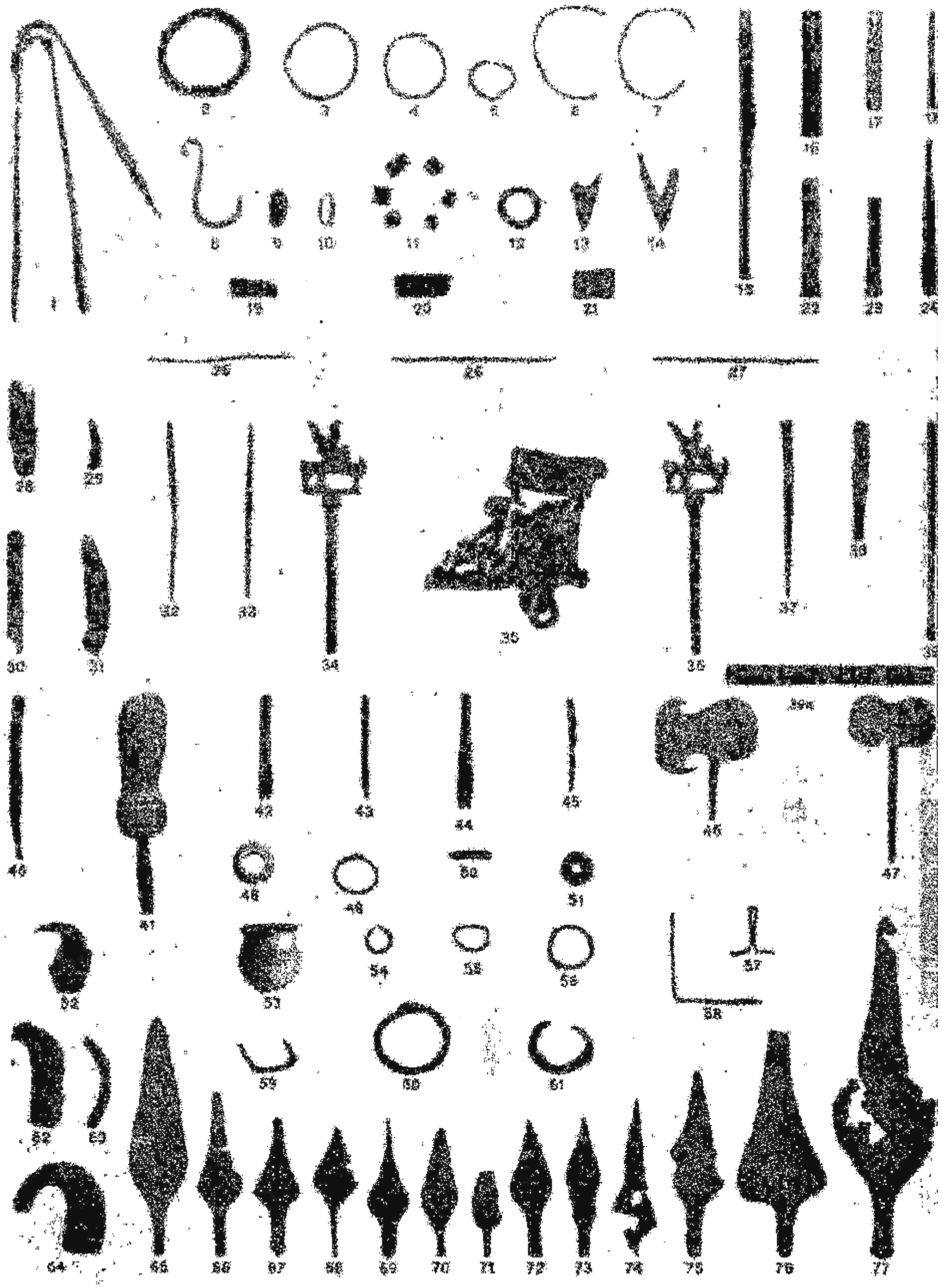

MIC, Pl. CXXV. Copper, bronze, silver and gold objects. Item 35 is referred to as an 'ekka'; it could also have been a box for a ratha.

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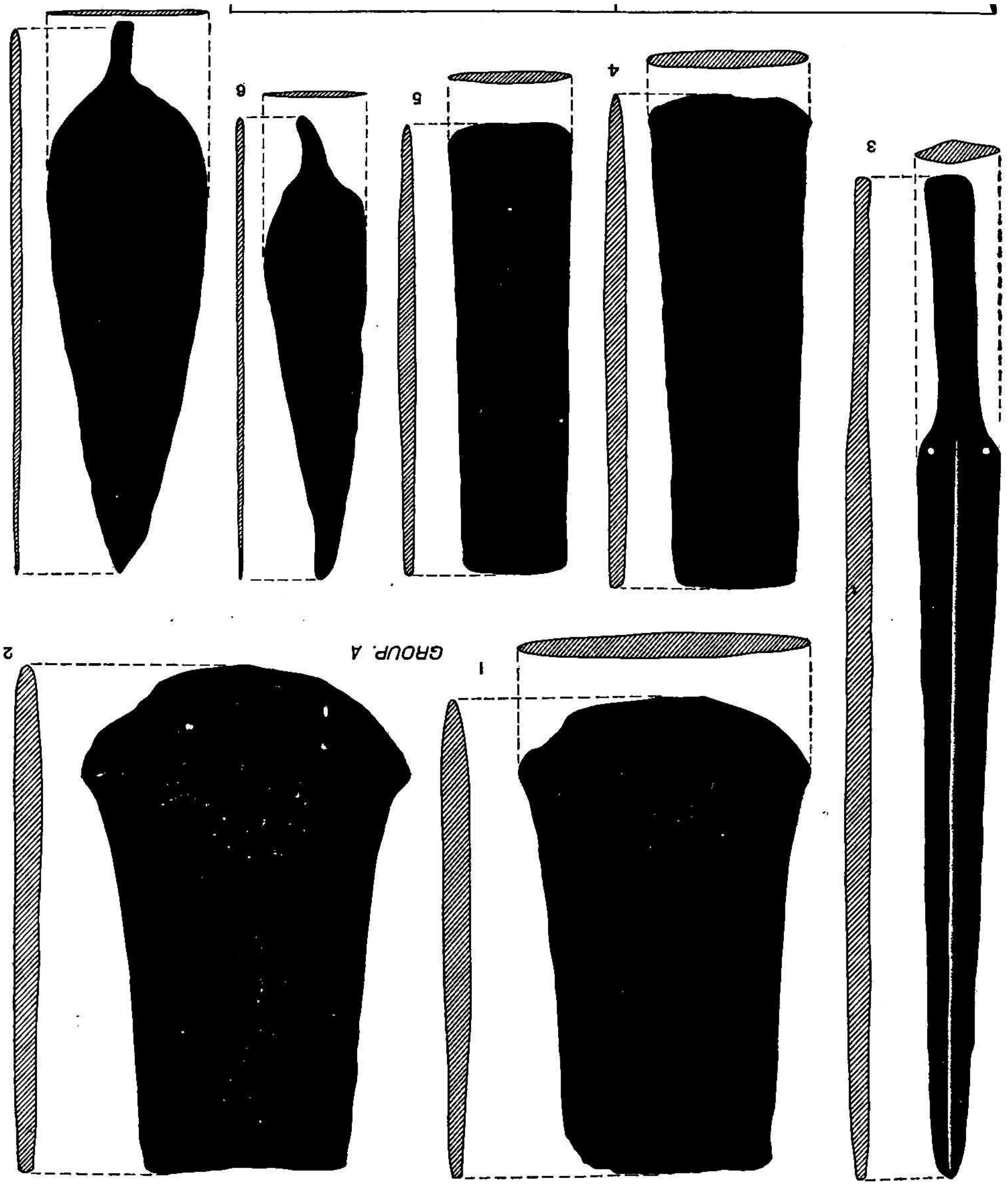

FEM, Pl. CXIII. Copper and bronze tools and implements.

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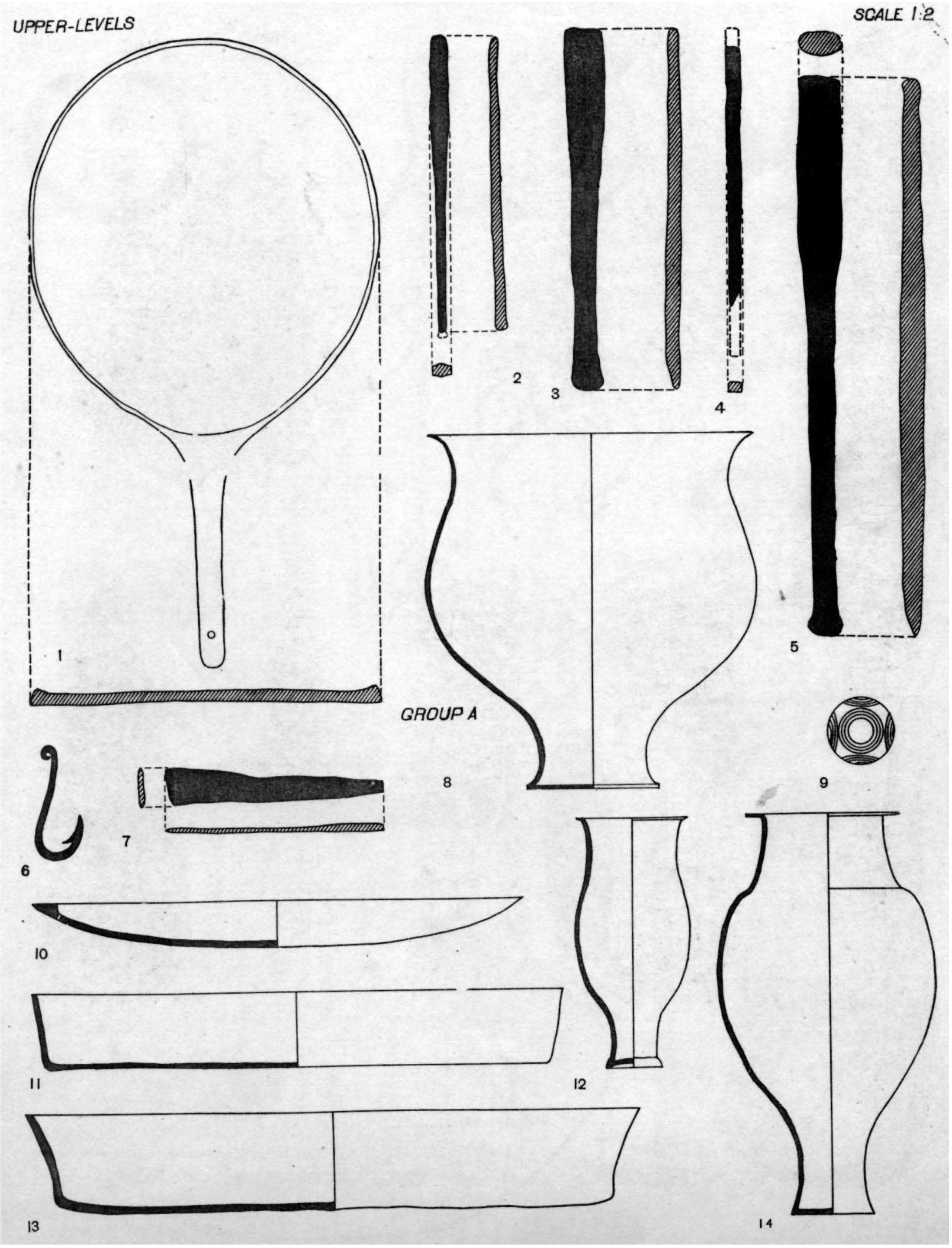

FEM, Pl. CXIV.Copper and bronze tools, implements and utensils

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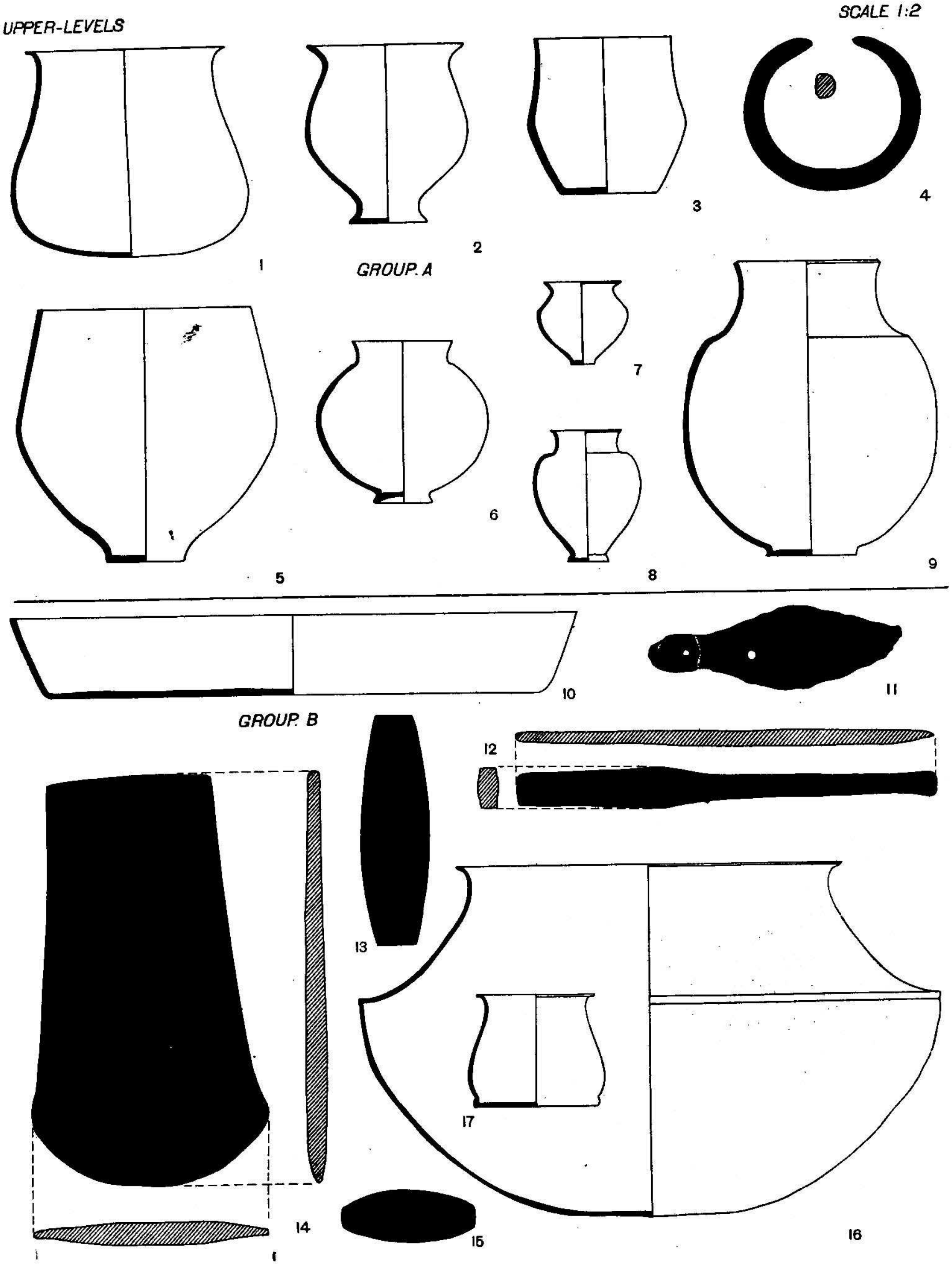

FEM, Pl. CXV. Copper and bronze utensils, tools and stone weights.

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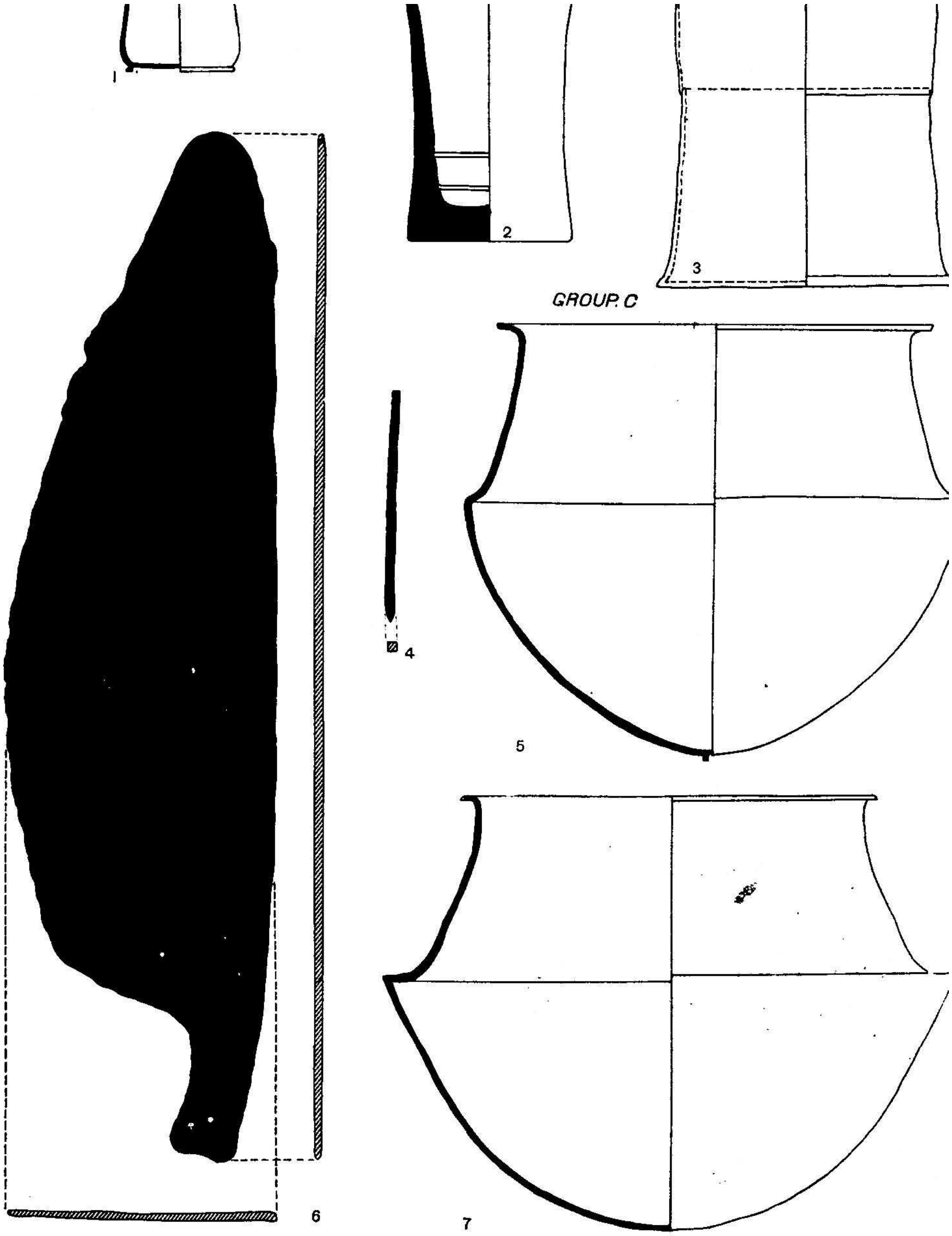

FEM. Pl. CXVI. Copper and bronze tools and utensils and stone vessel.

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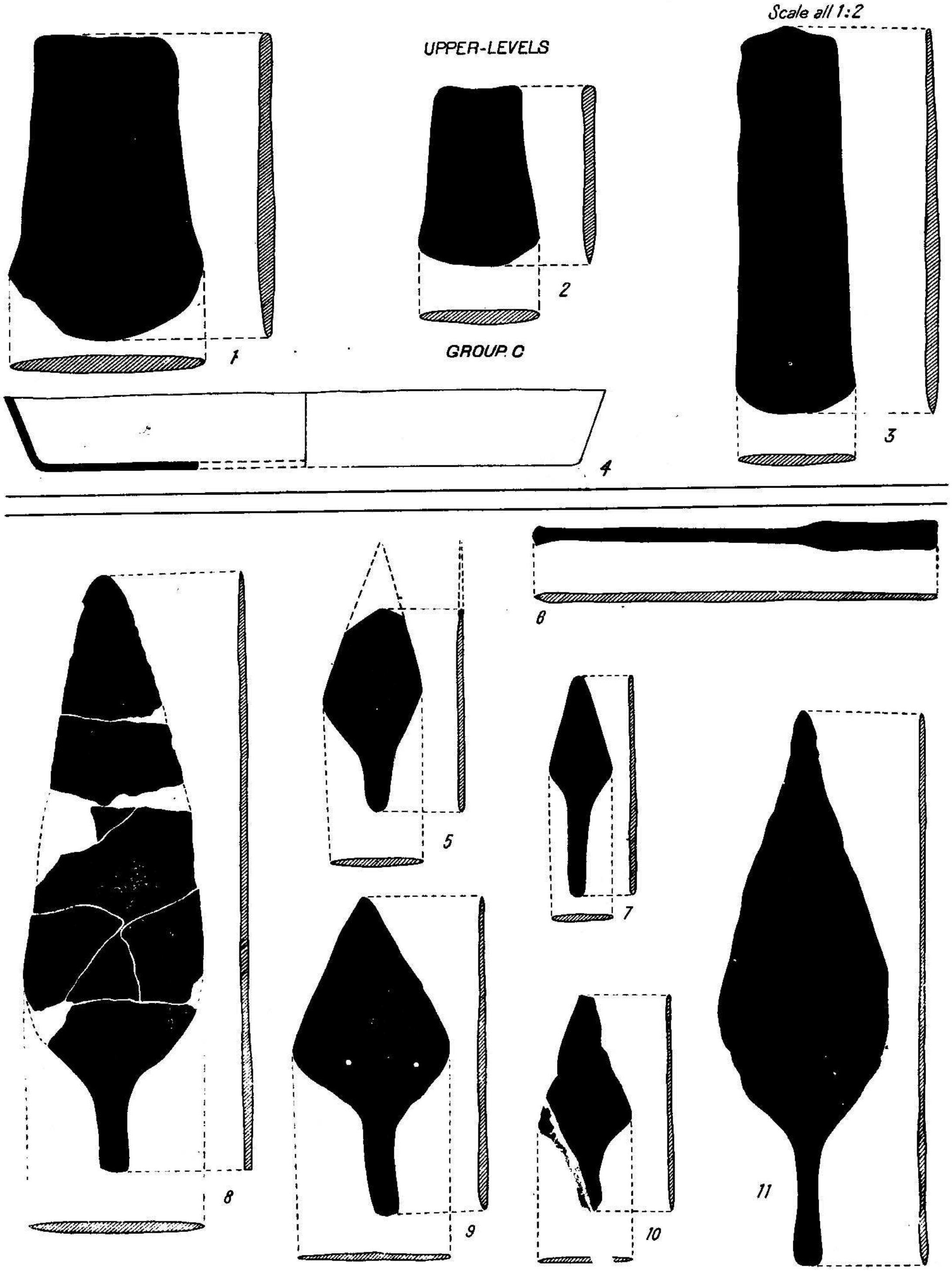

FEM. Pl. CXVII. Copper and bronze tools.

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FEM, Pl. CXVIII. Copper and bronze objects. Upper levels.

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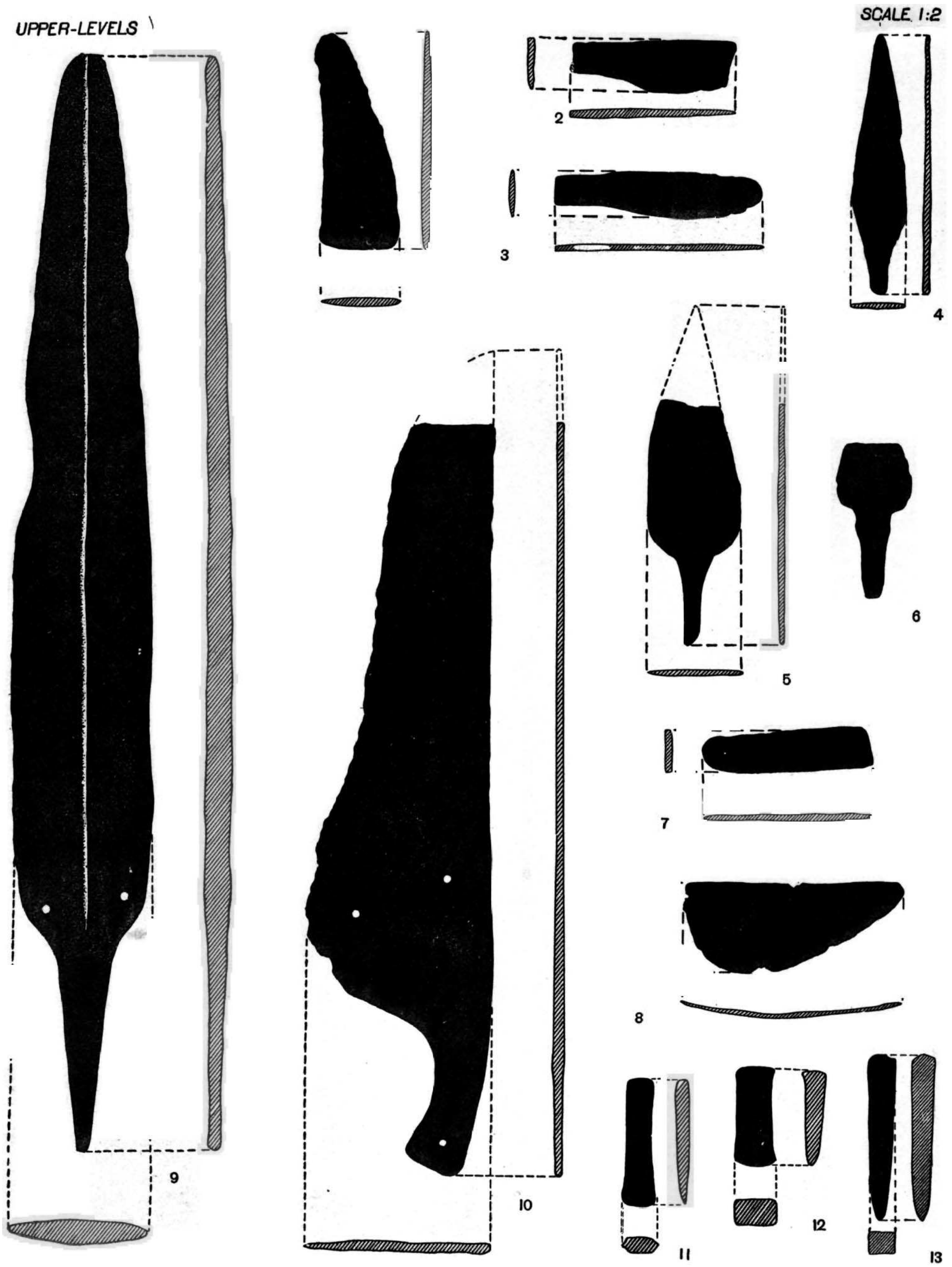

FEM, Pl. CXIX. Copper and bronze tools and implements.

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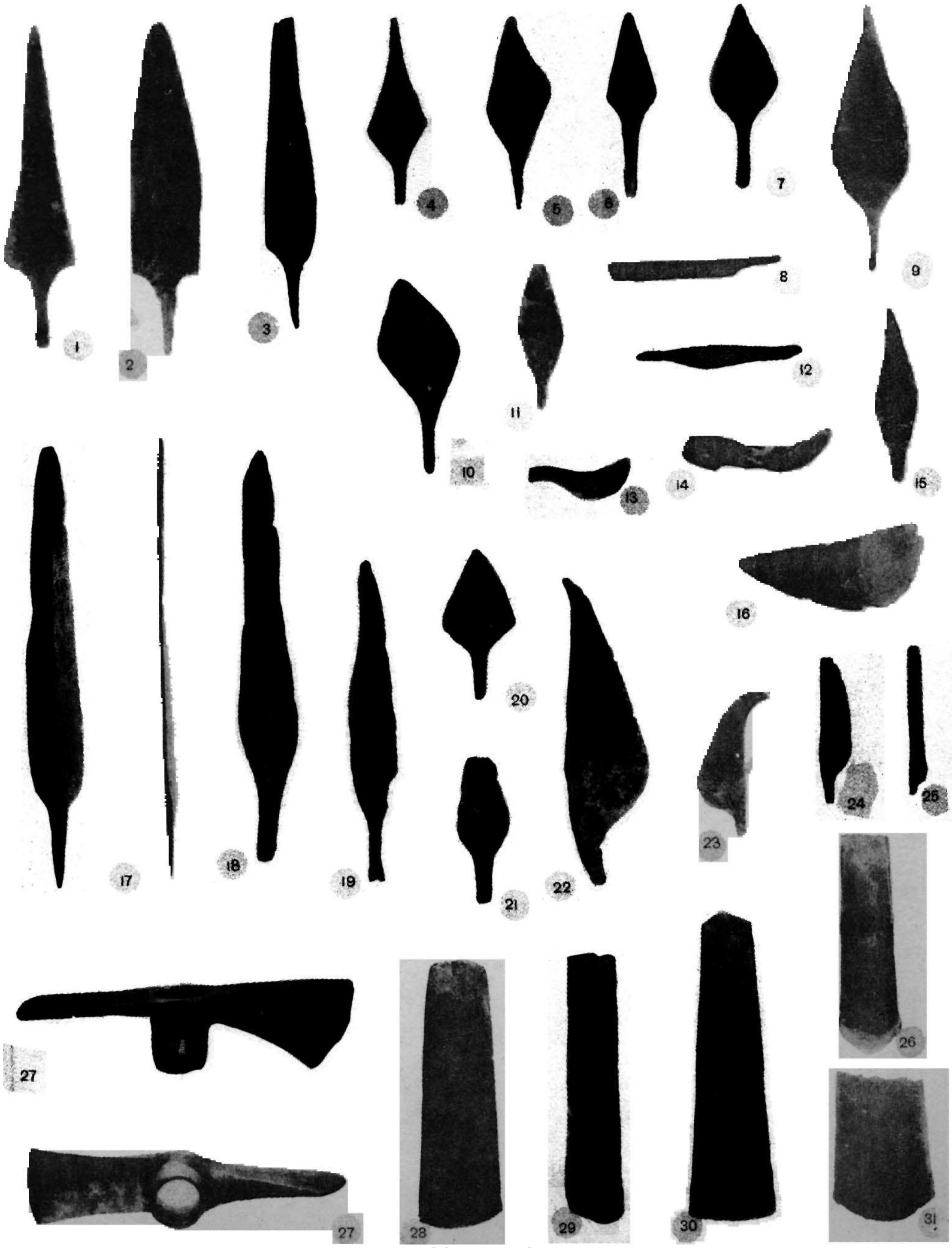

FEM, Pl. CXX. Copper and bronze implements. Upper levels.

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FEM. Pl. CXXI. Copper and bronze implements, tools and ornaments.

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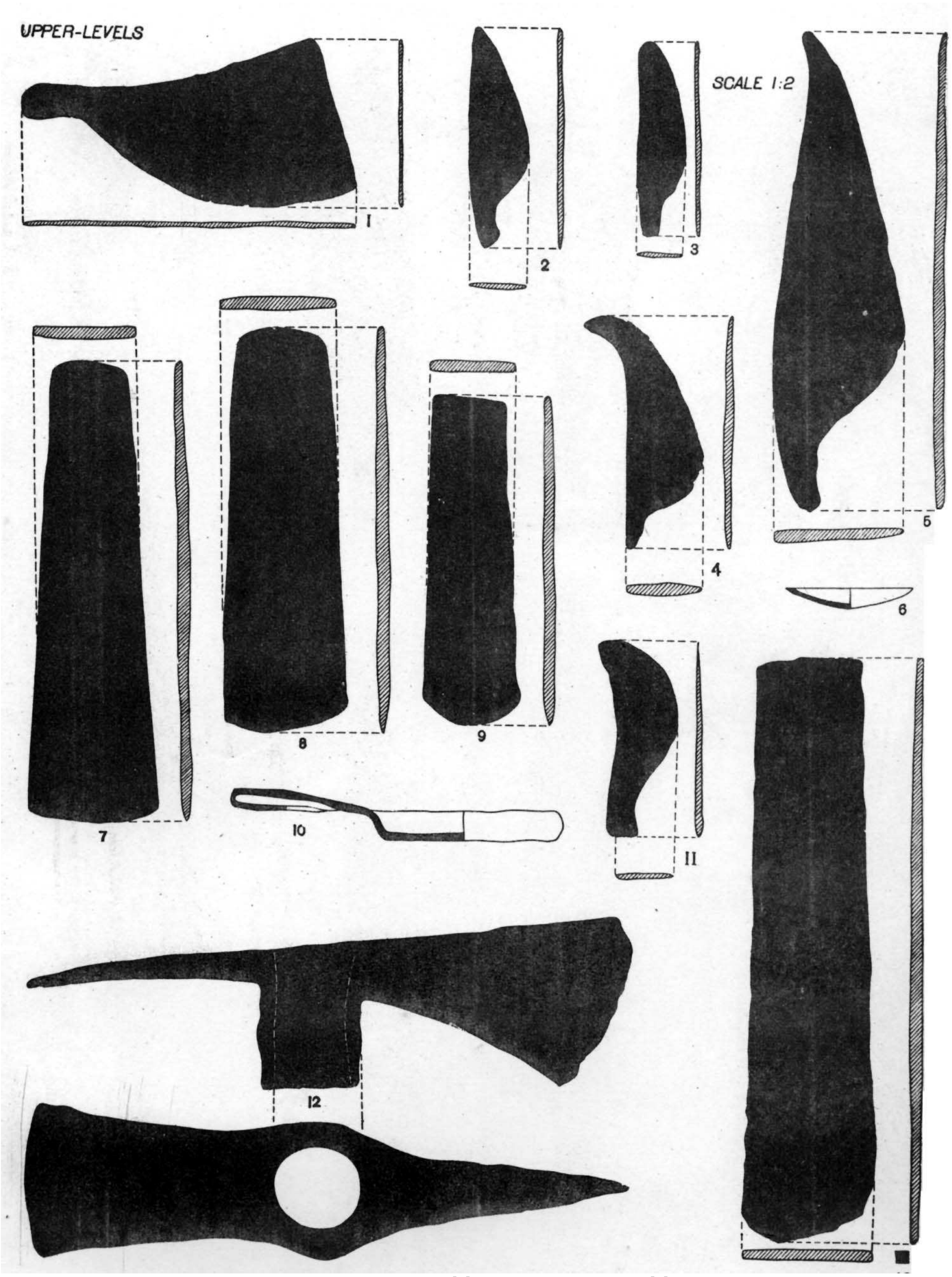

FEM, Pl. CXXII. Copper and bronze tools and implements.

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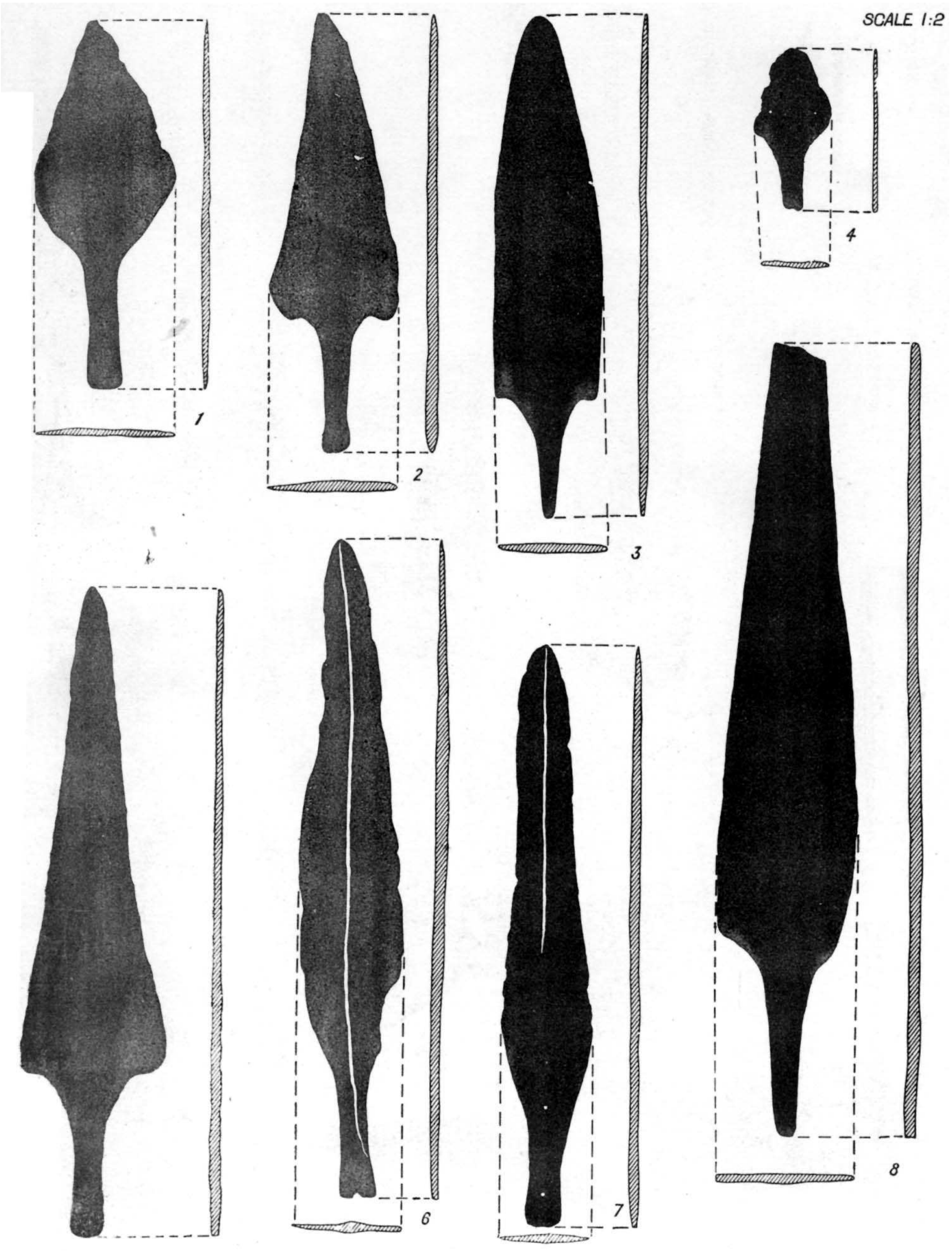

FEM. Pl. CXXIII. Copper and bronze knives and daggers.

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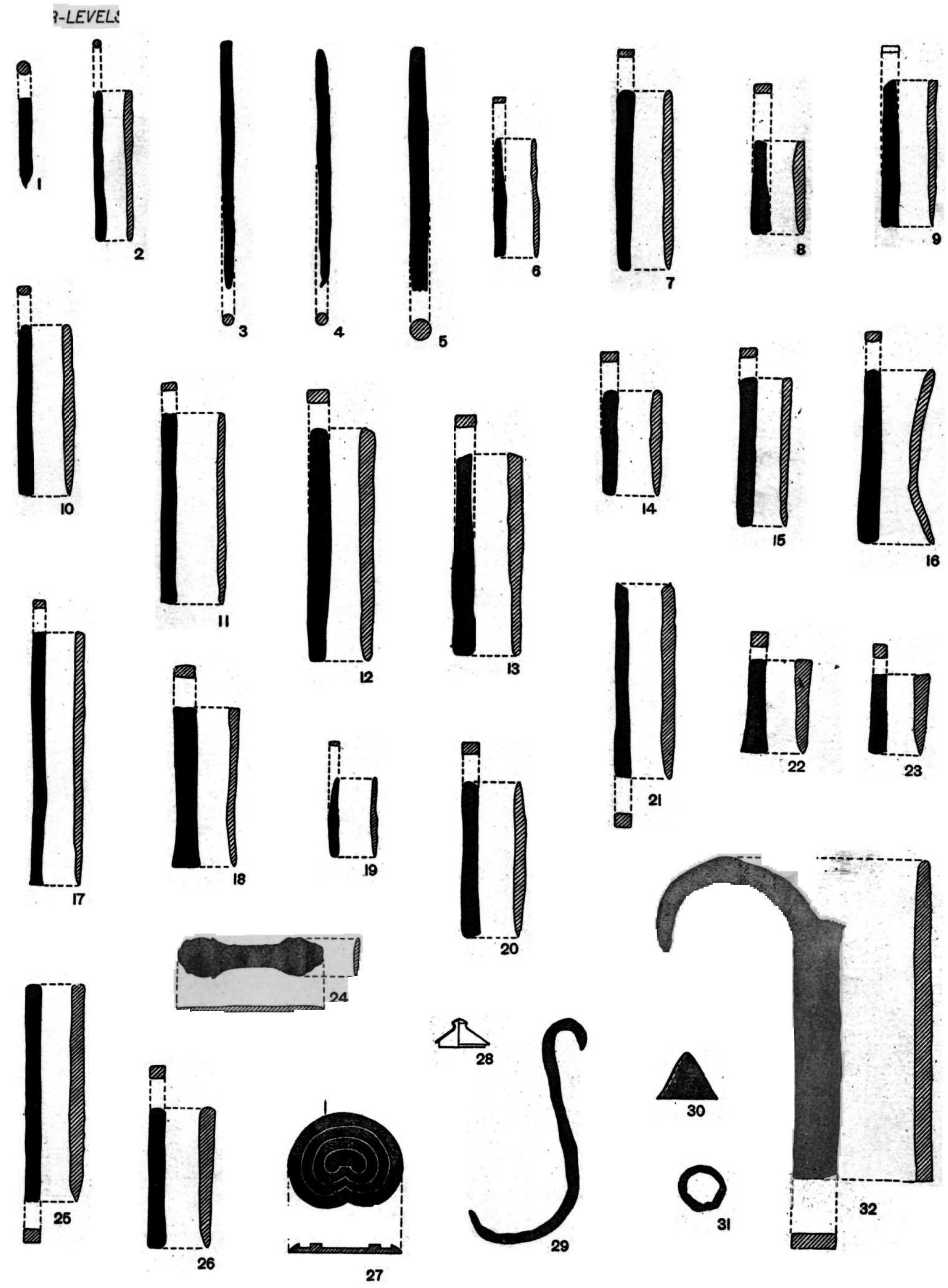

FEM. Pl. CXXIV. Copper and bronze objects.

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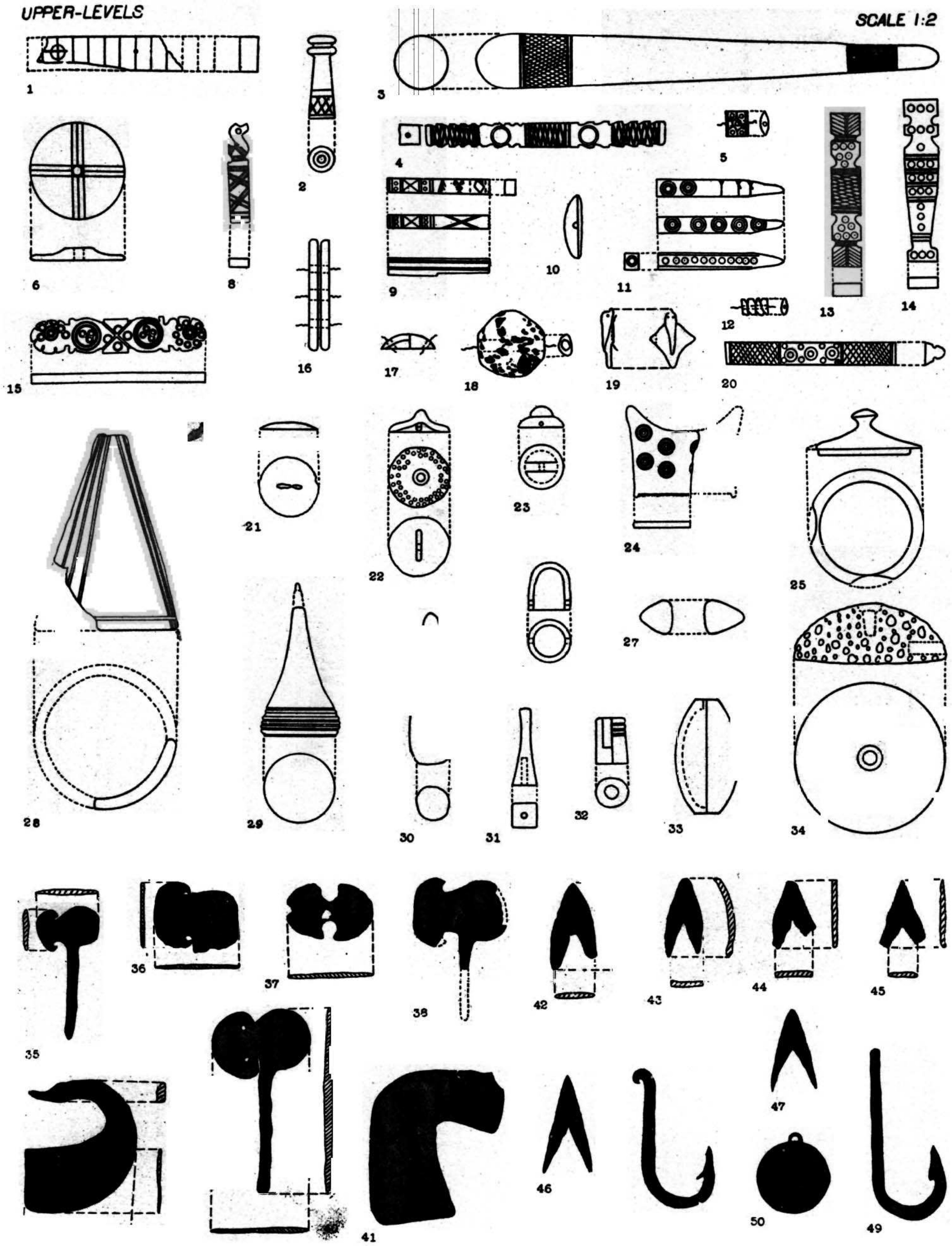

FEM. Pl. CXXV. Miscellaneous objects. Copper implements, arrowheads, fishhooks.

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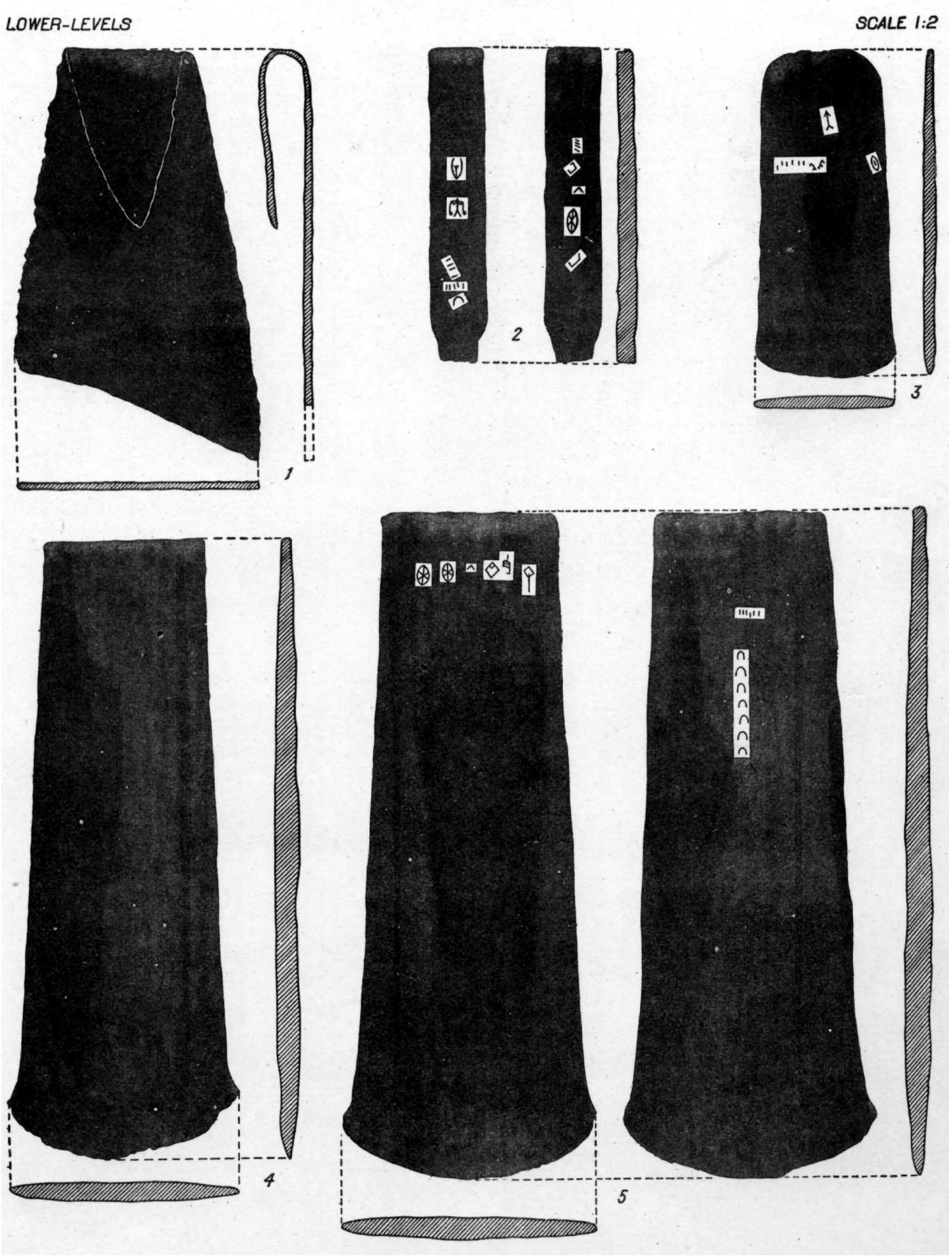

FEM. Pl. CXXVI. Copper and bronze implements and tools, some with inscriptions.

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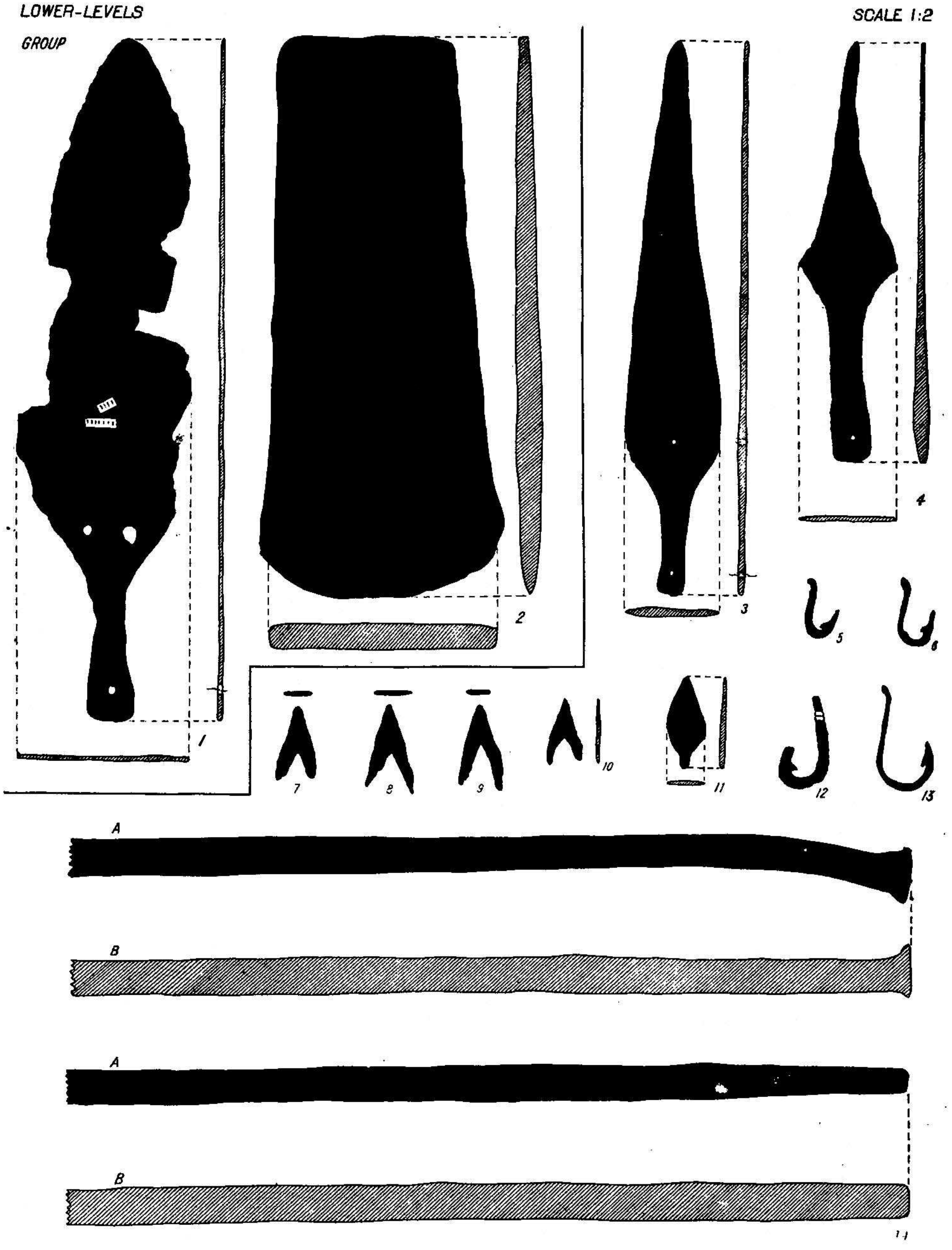

FEM, Pl. CXXVII. Copper and bronze objects.

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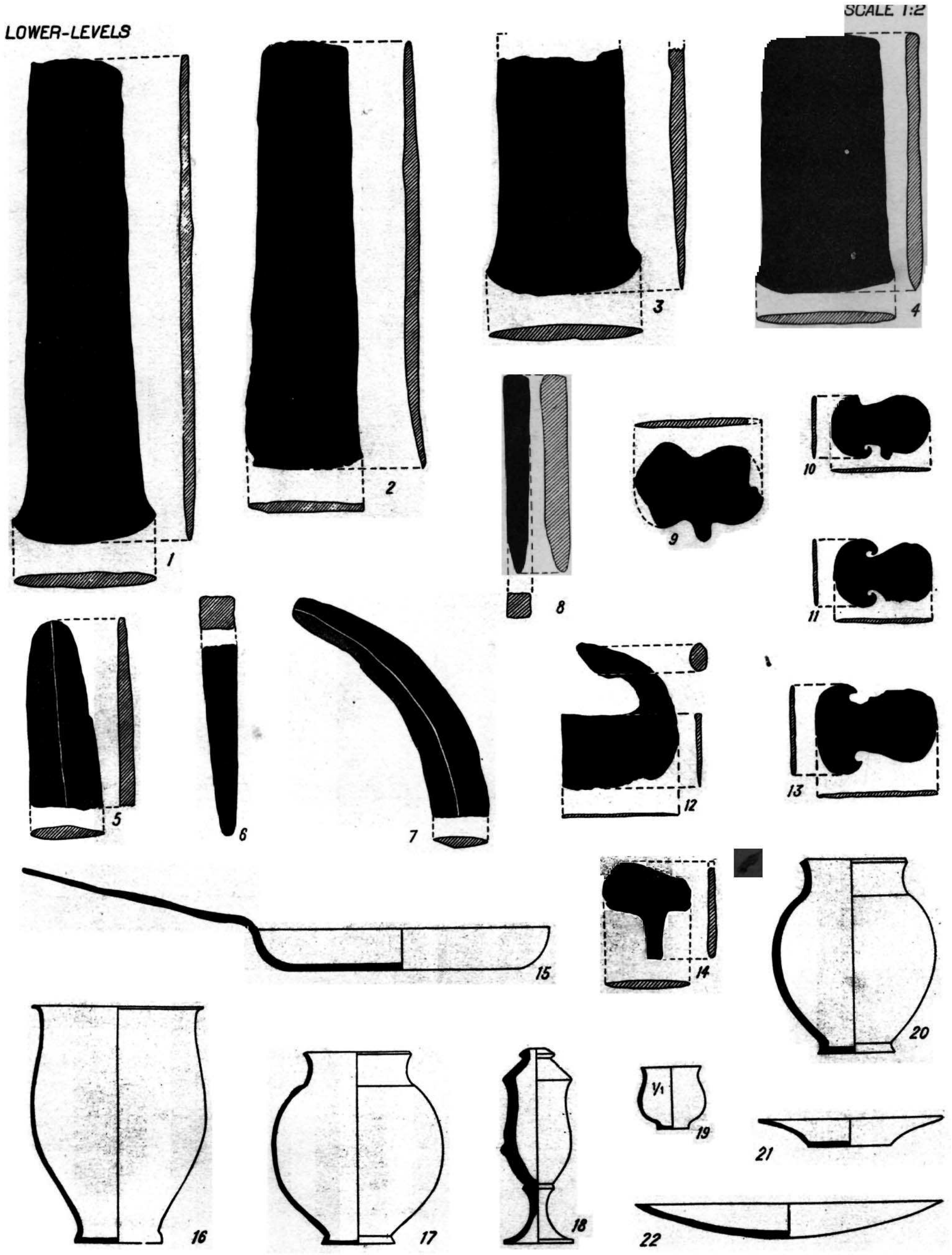

FEM. Pl. CXXVIII. Copper and bronze tools and utensils

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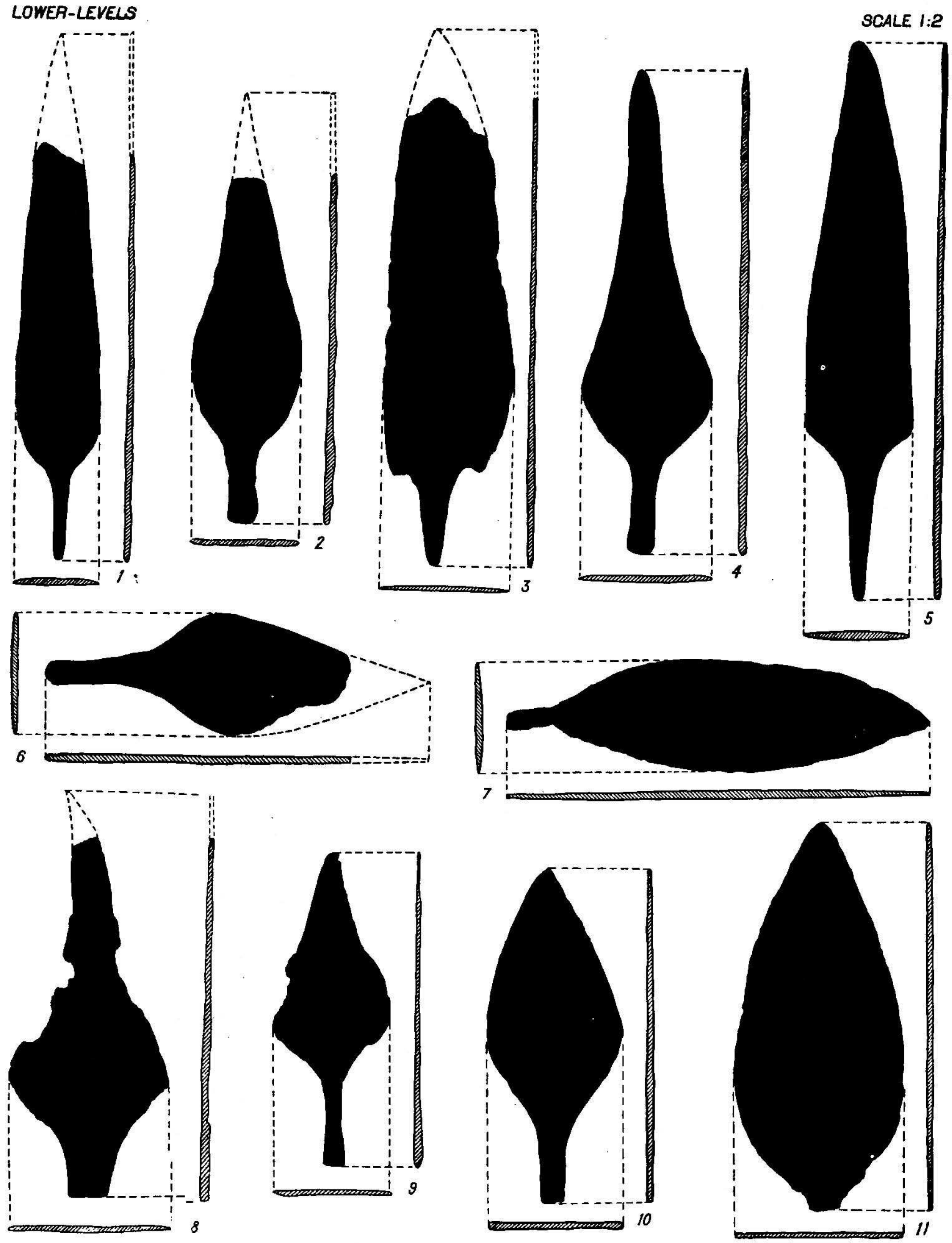

FEM. Pl. CXXIX. Copper and bronze knives and daggers.

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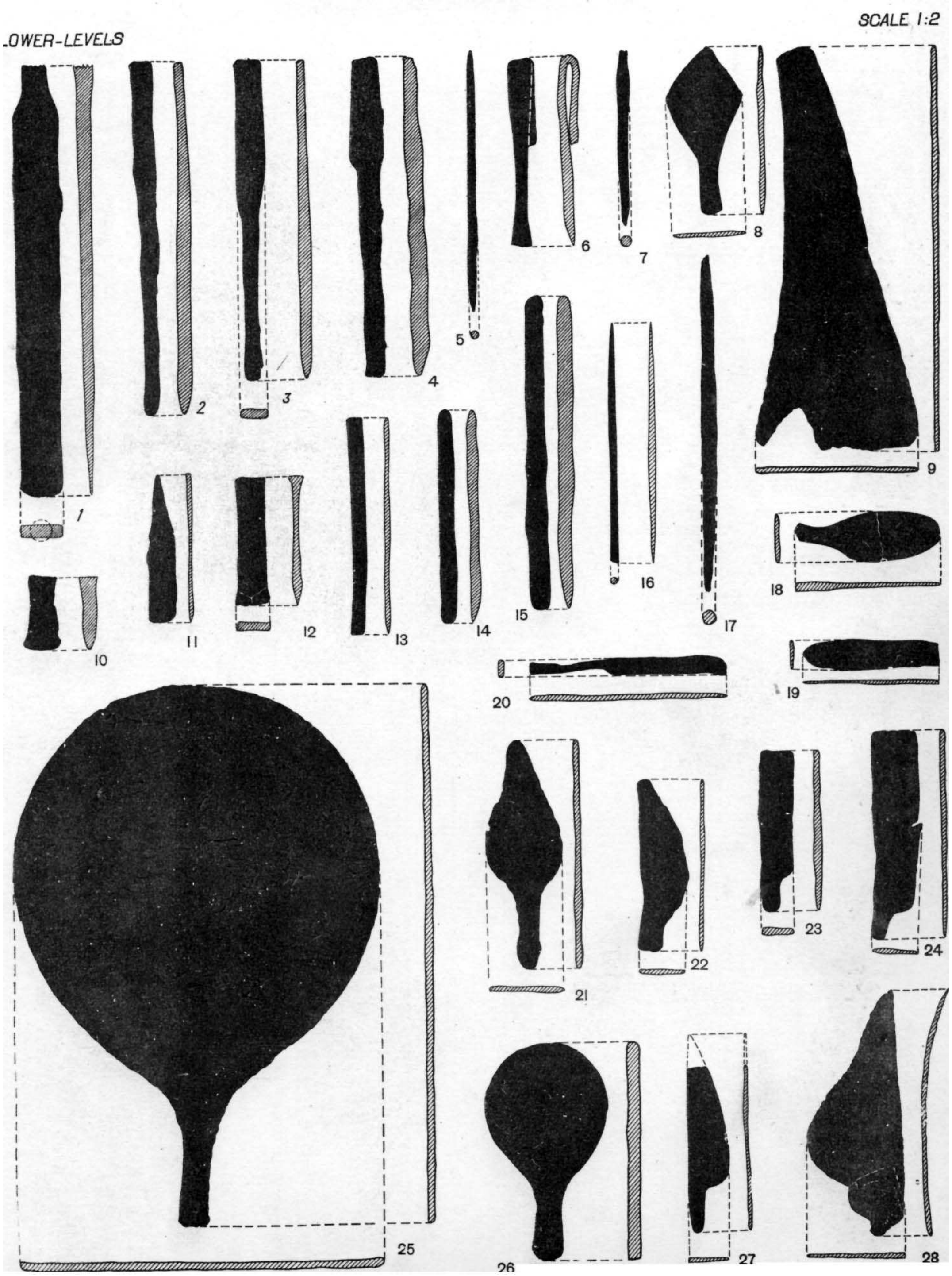

FEM, Pl. CXXX. Copper and bronze tools and other objects.

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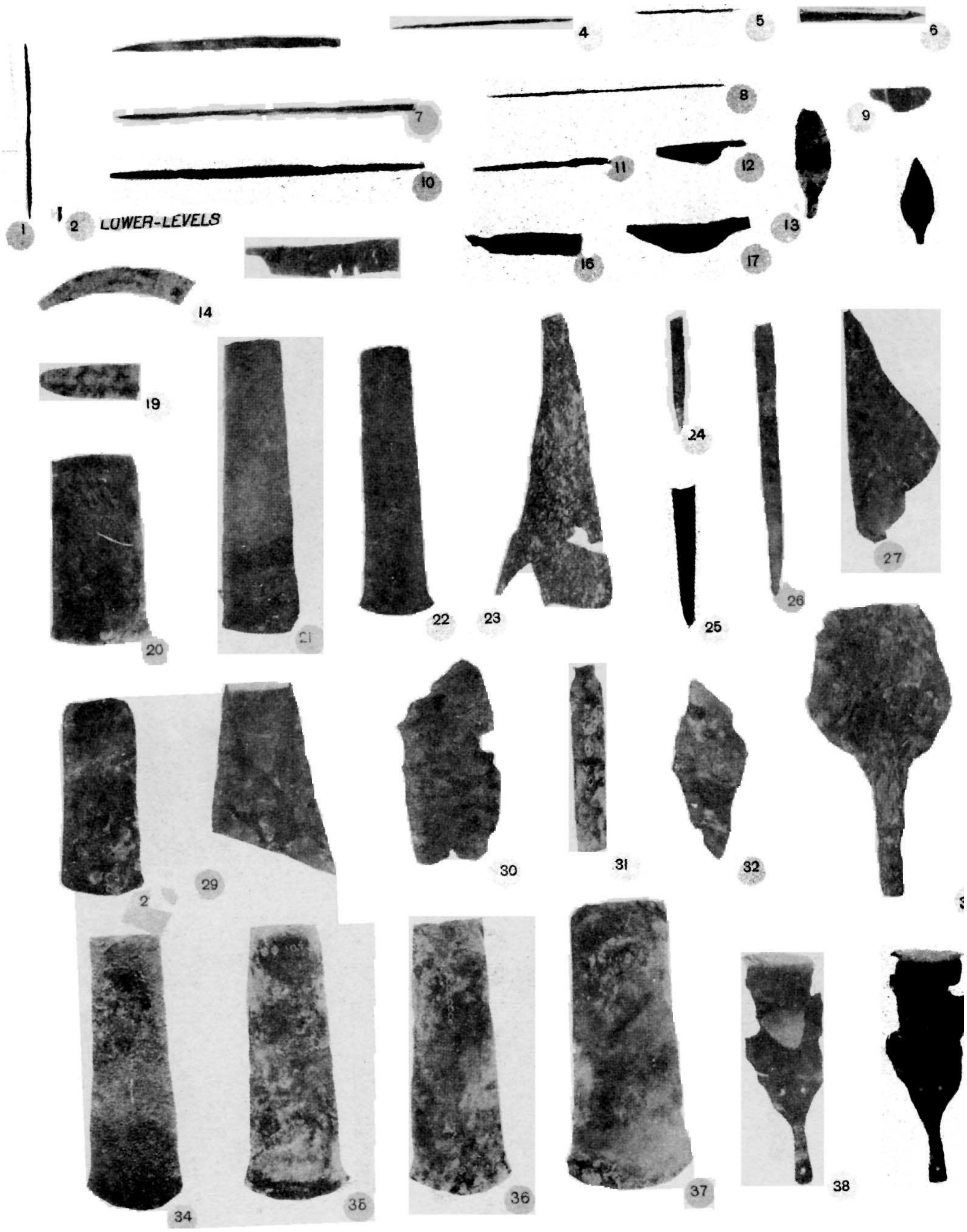

FEM. Pl. CXXXI. Copper and bronze tools and implements. Upper levels.

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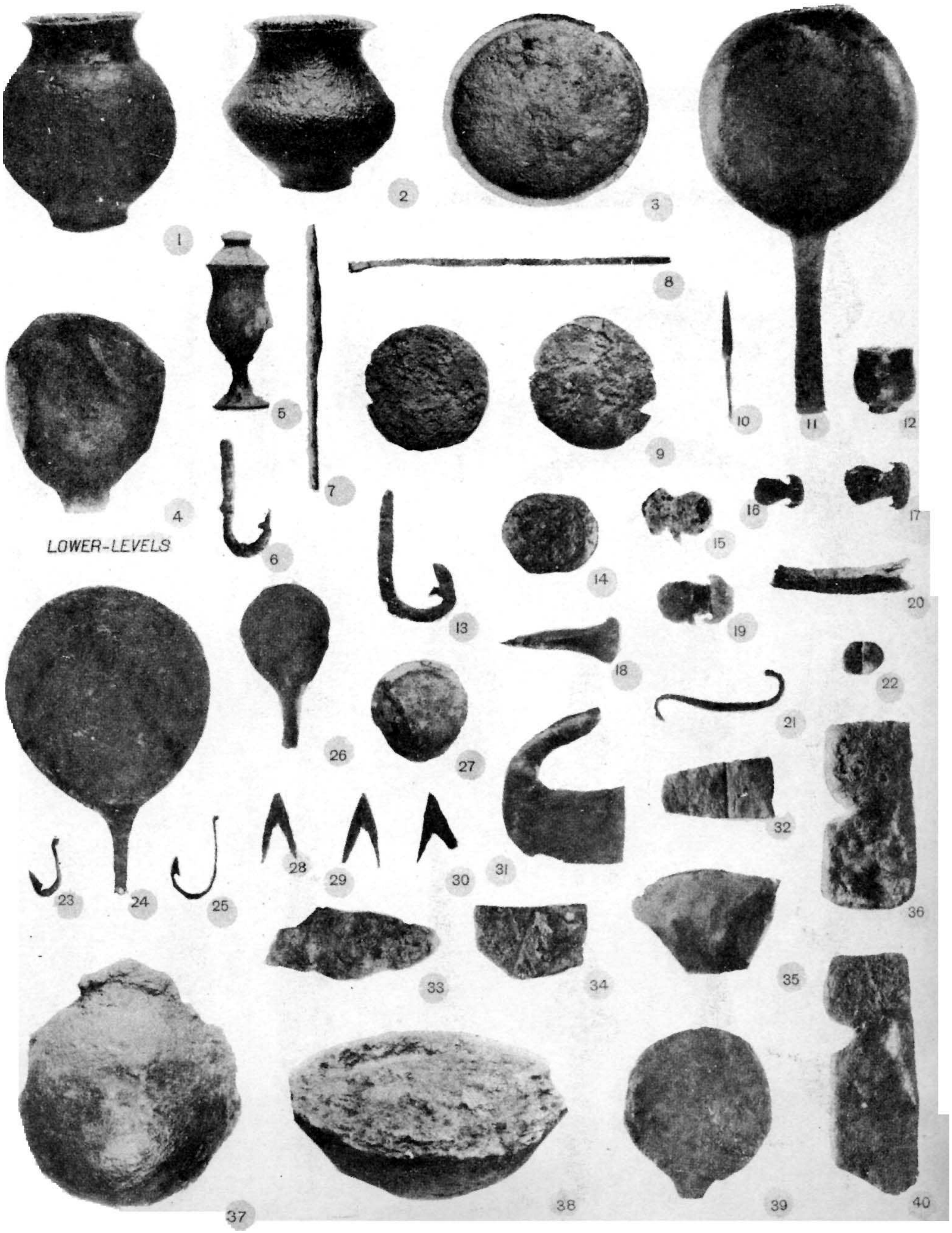

FEM. Pl. CXXXII. Copper and bronze utensils and other objects.

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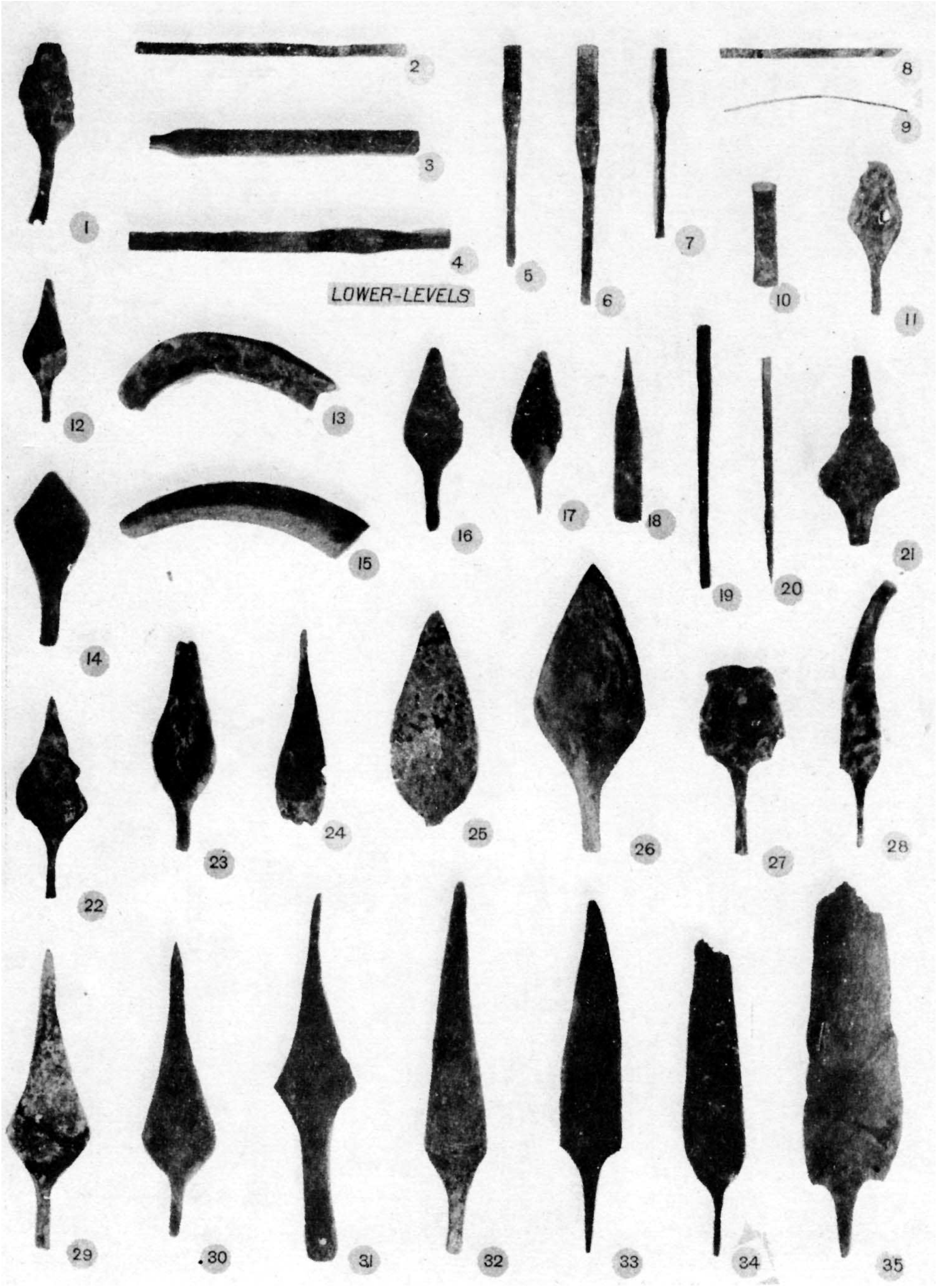

FEM. Pl. CXXXIII. Copper and bronze tools and implements.

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Chanhu-daro, Pl. LXXIV. Copper aqnd bronze tools and utensils: Harappa_ Culture. Items 1 and 1a are two sides of a blade incised with an inscription

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Chanhu-daro, Pl. LXXV.Copper and bronze implements and utensils: Harappa_ Culture.

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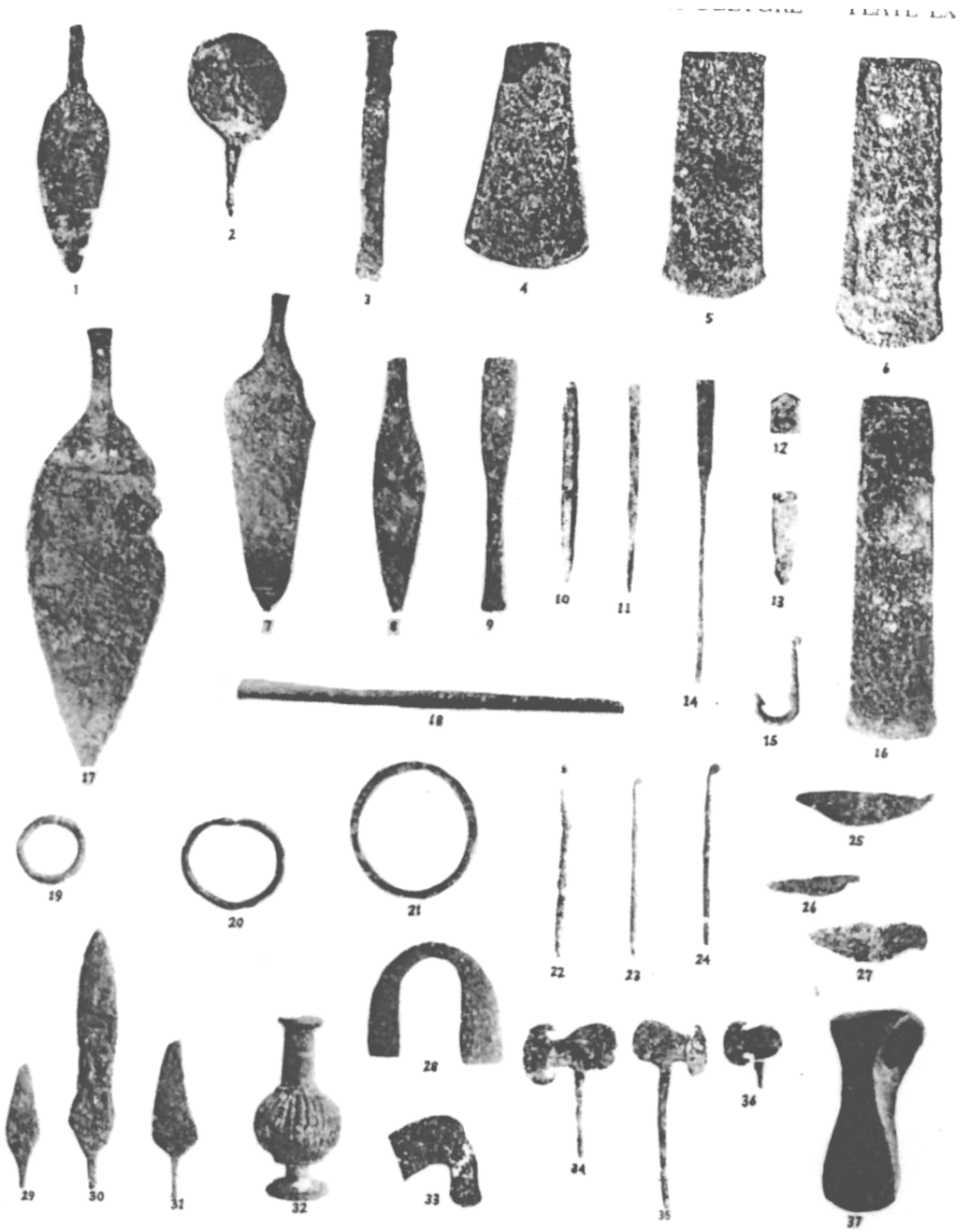

Chanhu-daro. Pl. LXXVI. Copper and bronze implements and tools: Harappa_ Culture.

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MIC, Pl. CXLIV. Copper and bronze figures and other objects. Items 5 and 6 are two views of a bronze, unpolished, of the ‘dancing girl’ bronze statue.

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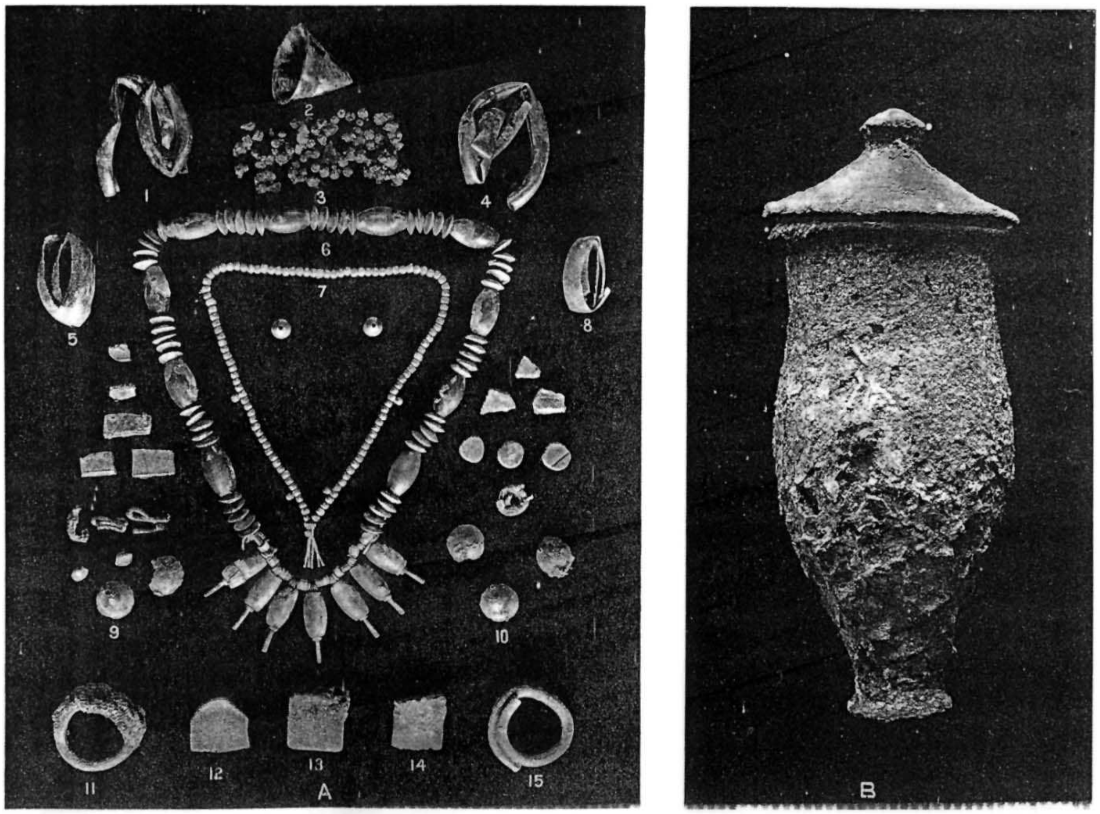
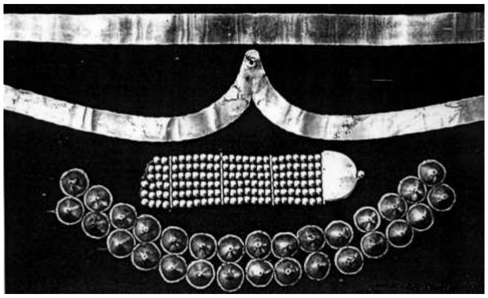


MIC, Pl. CXLVIII. Gold jewellery and silver vase.

Harapa. Terracotta figure; necklaces adorn the figure. [After Fig. 7.23 in JM Kenoyer, 1998].



Straight and curved gold fillets; beaded choker; thirty hollow cap-shaped gold ornaments with tiny hoops on the inside of the tip. [After Fig. 7.38 in JM Kenoyer, 1998]. Fifty-four smaller gold caps were found in a hoard at Harappa that may have been sewn onto clothing or a belt; one bearded male terracotta figure is shown wearing a skirt or wide belt covered with conical projections which may be this type of gold caps.

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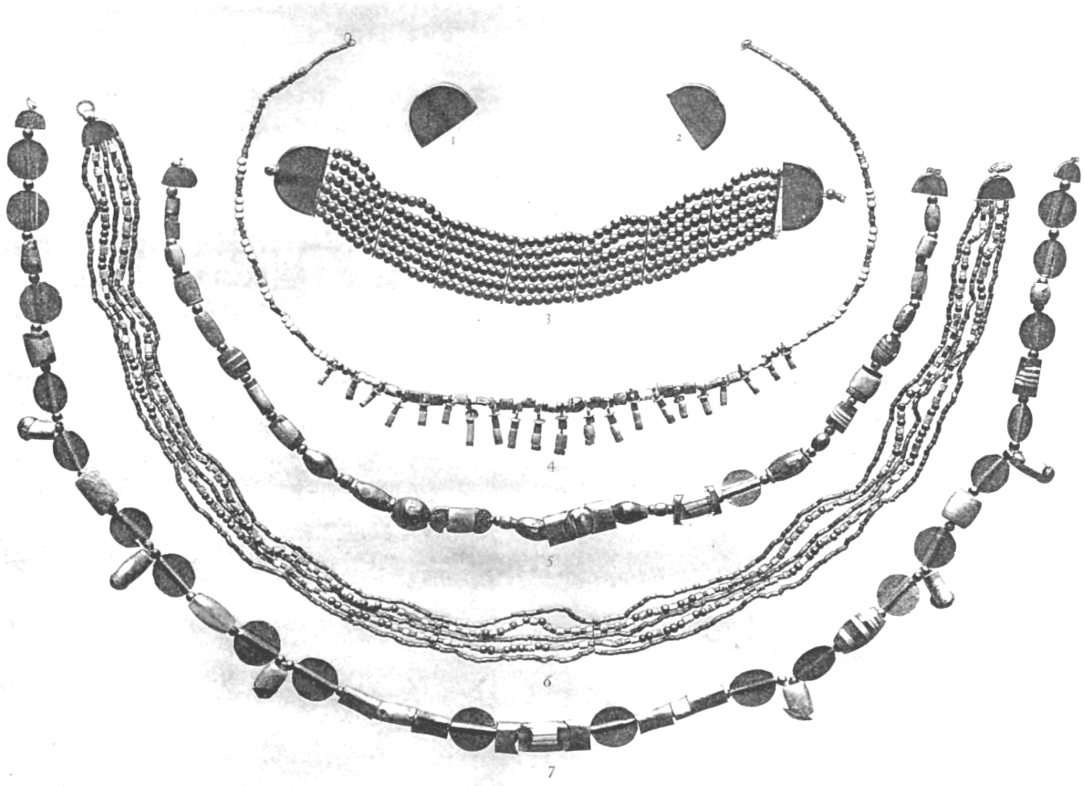

MIC, Pl. CXLIX. Jewellery.

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MIC, Pl. CL. Stone beads.

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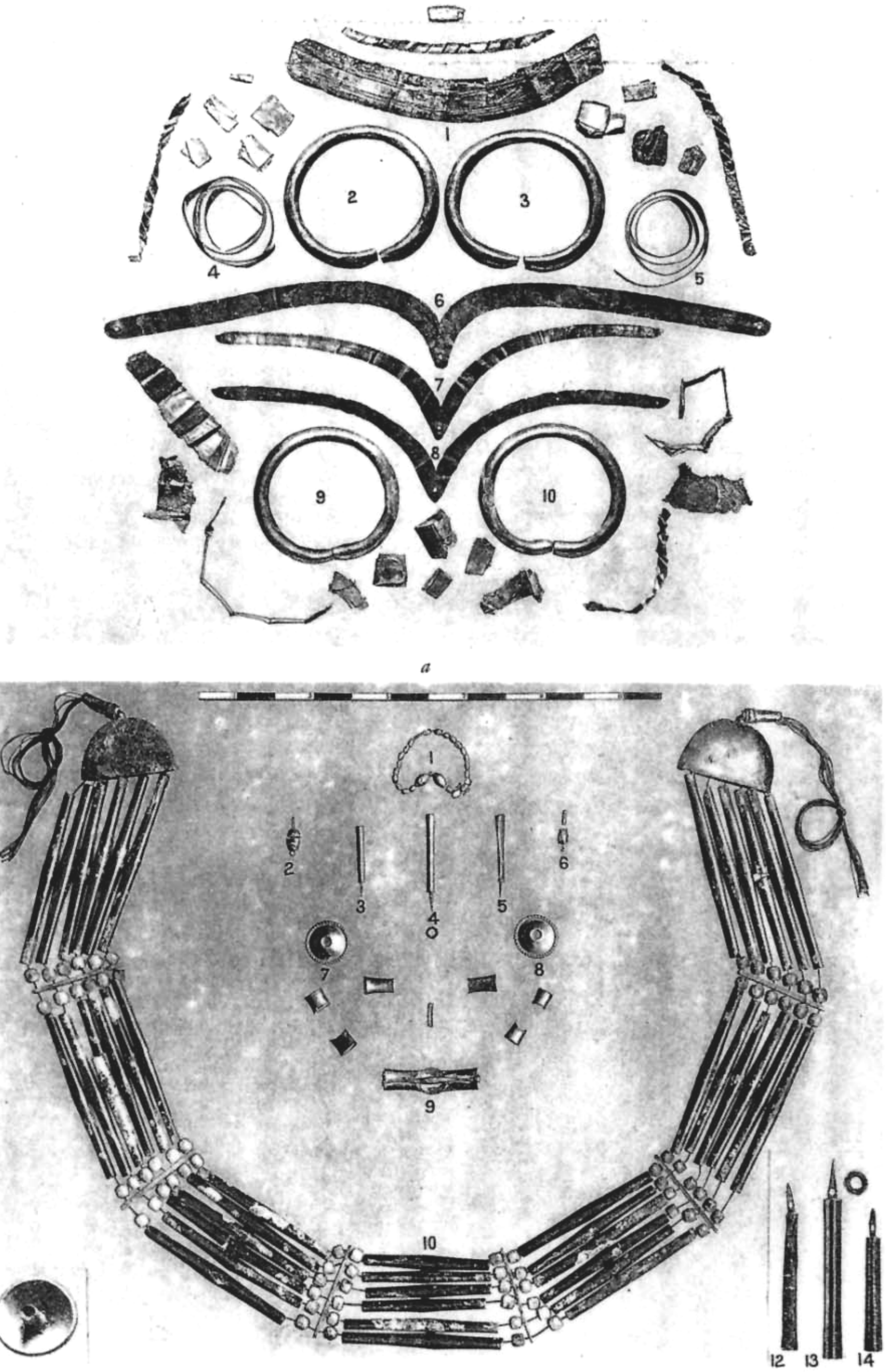

MIC, Pl. CLI. Jewellery.

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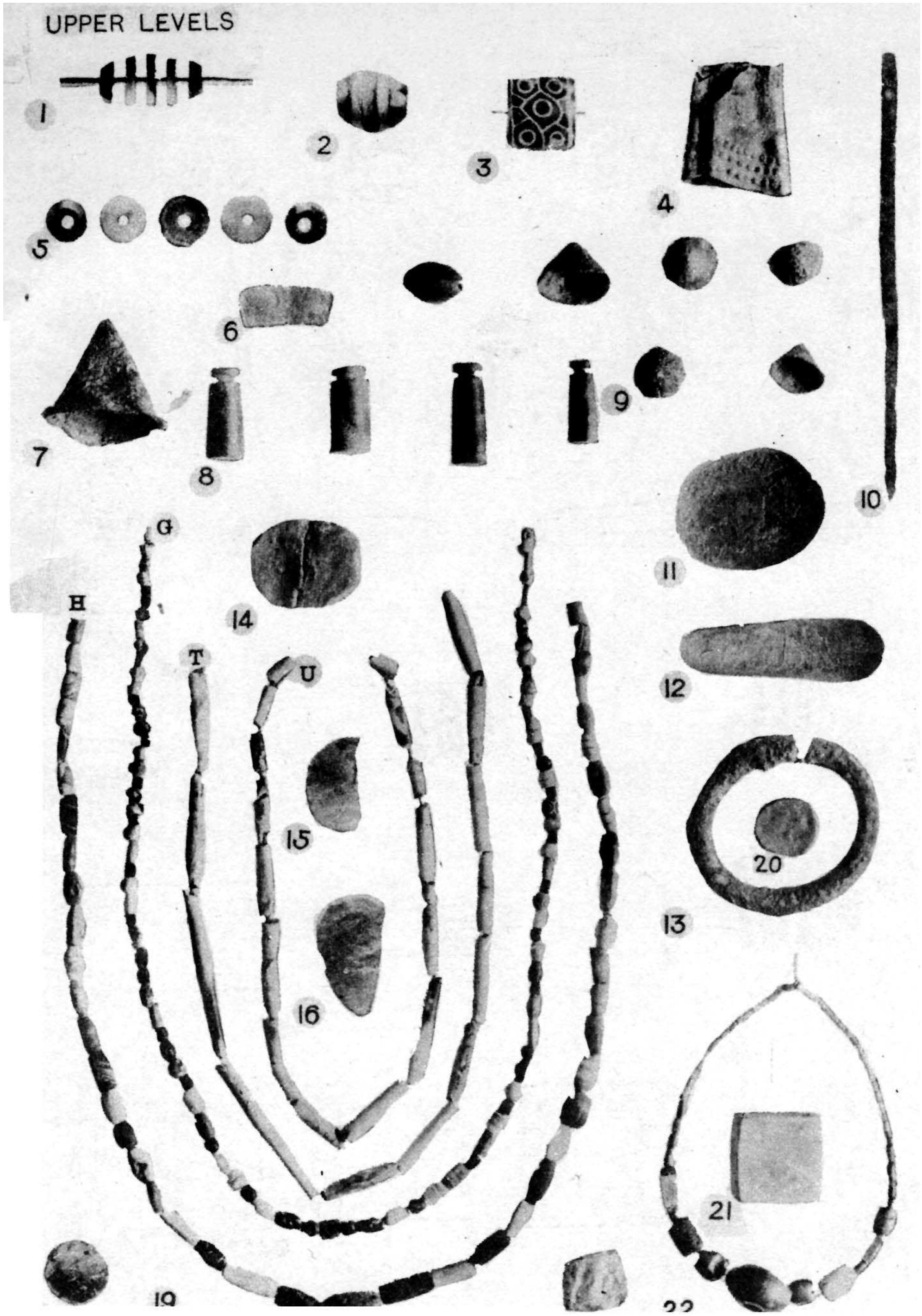

FEM. Pl. CXXXV. Beads, cones and other objects

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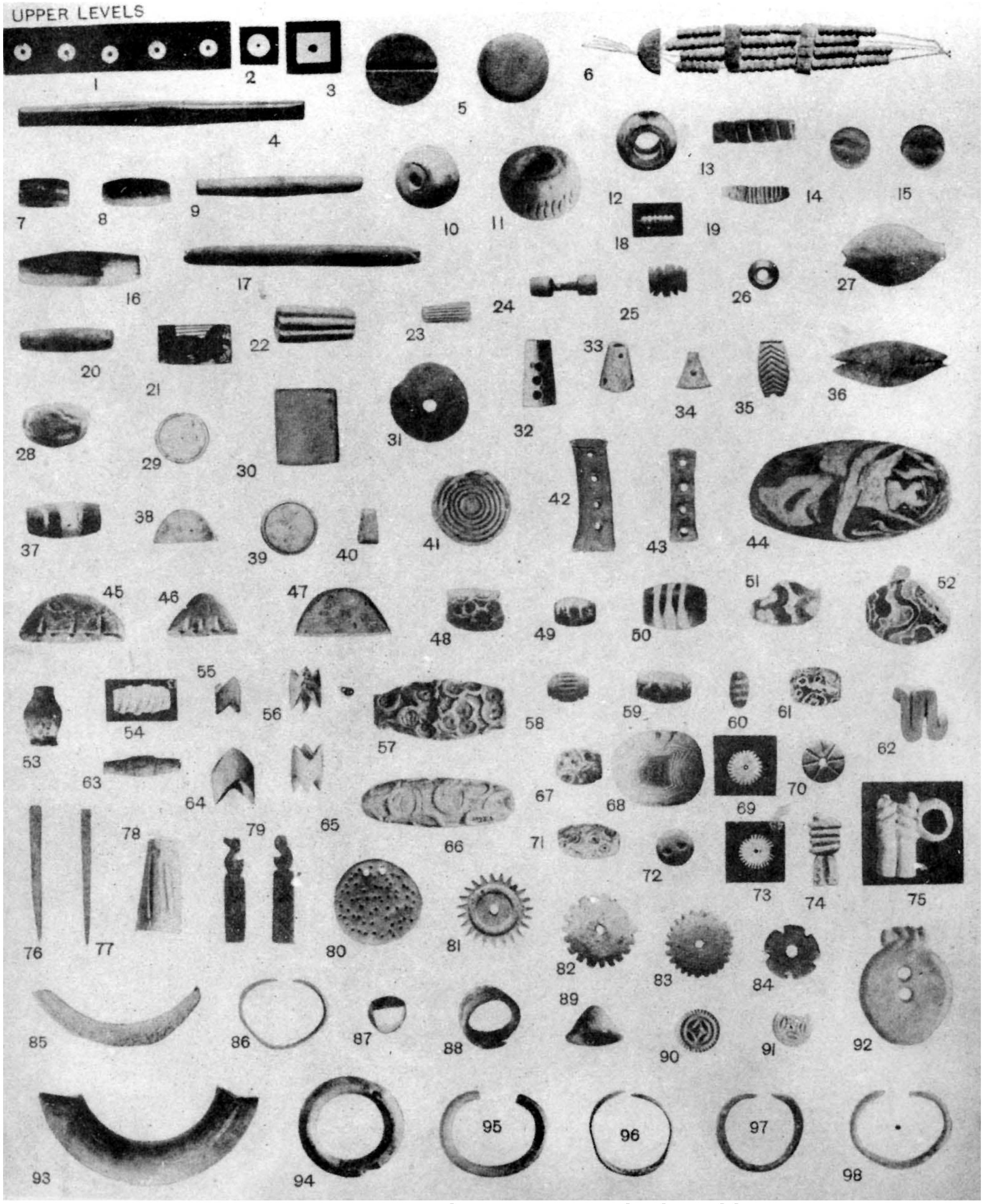

FEM. Pl. CXXXVI. Beads,. Amulets and other objects

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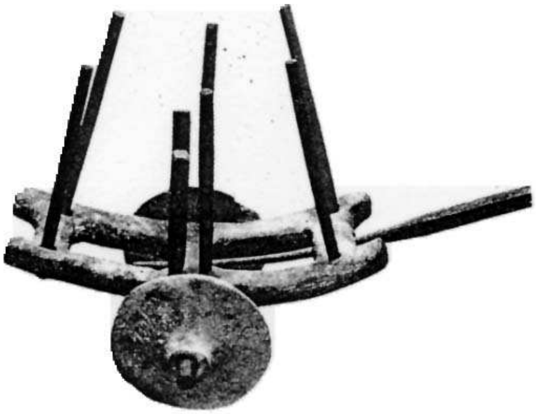
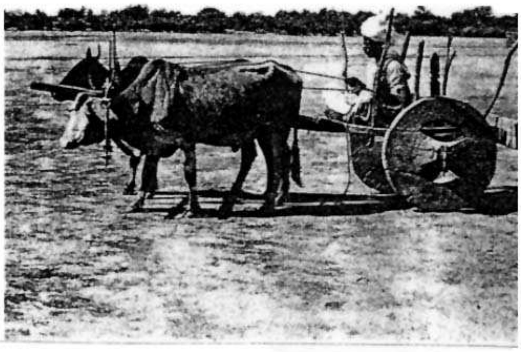
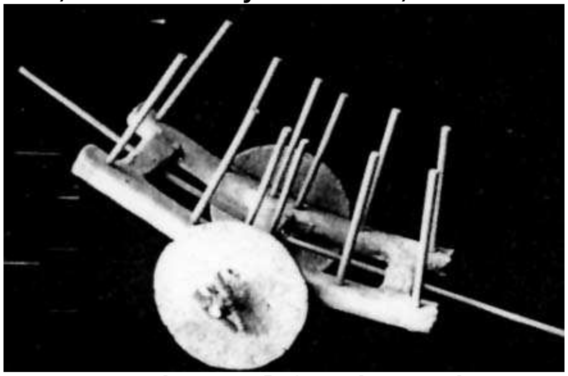




MIC, Pl. CLIV, 10 and 11. Toy cart model; Cart in use in Sindh.



Nausharo. Teracotta model cart. [After Fig. 5.17 in JM Kenoyer, 1998]

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Chanhu-daro. Pl. LVIII. Toys: Harappa_ Culture.

MIC, Pl. CLVIII,1. Pin-head with a deer motif and dotted circles on the body.

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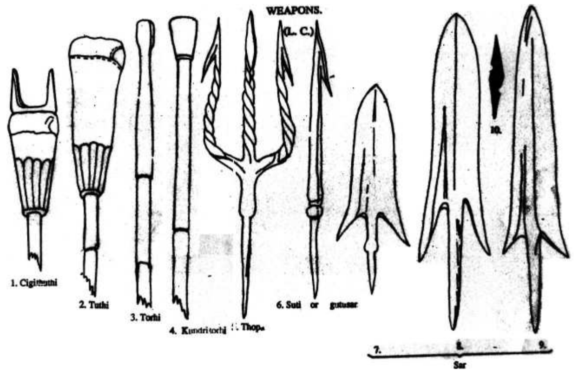
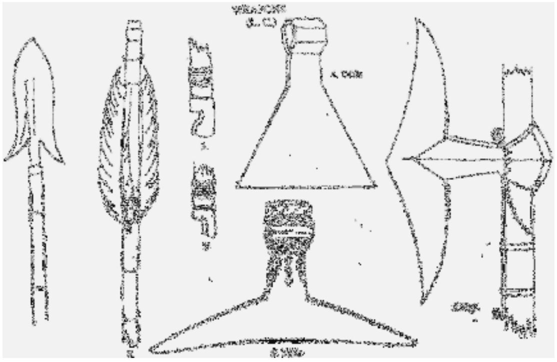
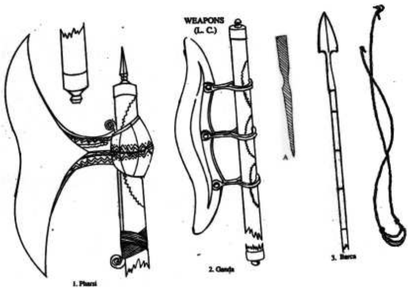


1.Cigithuthi; 2. Tuthi; 3. Torhi; 4. Kundritorhi; 5. Thopa; 6. Suti or gatusar; 7,8,9. sar [After Pl. II in: John Hoffmann and Arthur Van Emelen, 1990, *Encyclopaedia Mundarica*, Vol. XVI]

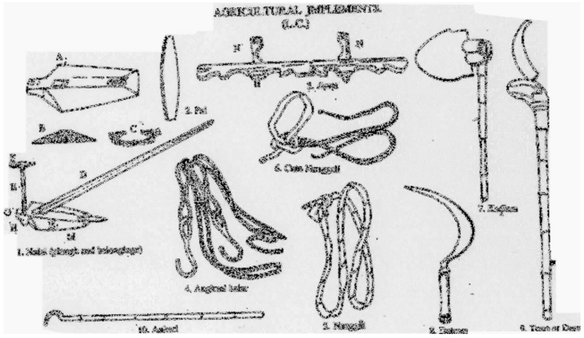
1 to 3. Sar; 4,5. Tabla; 6. kapi [After Pl. III in: John Hoffmann and Arthur Van Emelen, 1990, *Encyclopaedia Mundarica*, Vol. XVI]



Pharsi; 2. Gan.d.a; 3. Barca; 4. Dhelkusi [After Pl. III in: John Hoffmann and Arthur Van Emelen, 1990, *Encyclopaedia Mundarica*, Vol. XVI]



1.Naial (plough and belongings); 2. Pal; 3. Ar.ara; 4. Angkusi baiar; 5. Nanggal; 6. Cutn Nanggali; 7. Kudlam; 8. Datrom; 9. Tono or Duru; 10. Ankari [After Pl. XIII in: John Hoffmann and Arthur Van Emelen, 1990, *Encyclopaedia Mundarica*, Vol. XVI]



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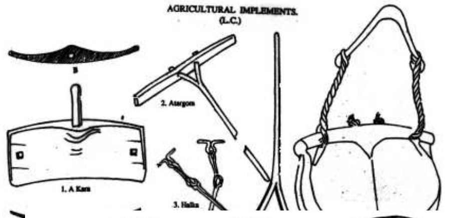
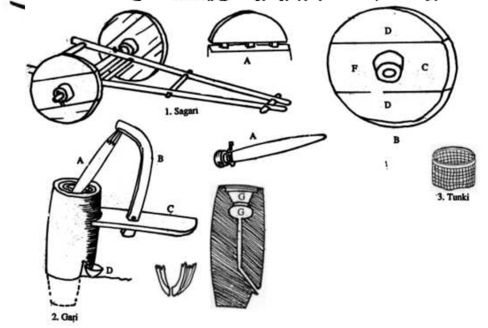
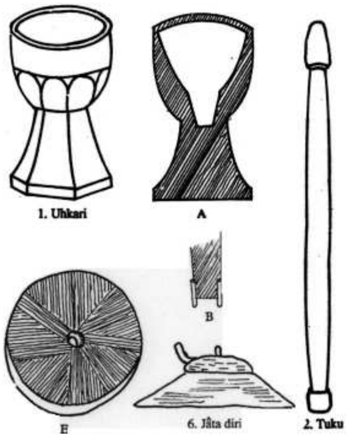


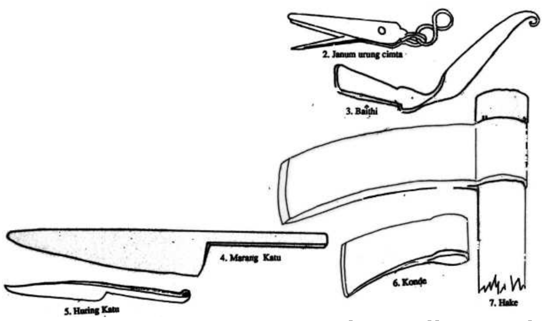
1. A Kara; 2. Atargom; 3. Halka; 4. Kara dand.a; 5. Bai^sli [After Pl. XIV in: John Hoffmann and Arthur Van Emelen, 1990, *Encyclopaedia Mundarica*, Vol. XVI]



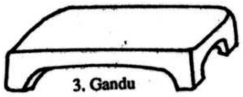
1. Sagari; 2. Gar.i; 3. Tunki or Dali [After Pl. XV in: John Hoffmann and Arthur Van Emelen, 1990, *Encyclopaedia Mundarica*, Vol. XVI]

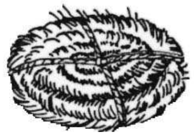


1. Uhkari; 2. Tuku; 6. Ja^ta diri [After Pl. XVIII in: John Hoffmann and Arthur Van Emelen, 1990, *Encyclopaedia Mundarica*, Vol. XVI]



Janum urung cimta; 3. Bai^t.hi; 4. Marang Katu; 5. Huring Katu; 6. Kond.e; 7. Hake [After Pl. XX in: John Hoffmann and Arthur Van Emelen, 1990, *Encyclopaedia Mundarica*, Vol. XVI]





Gandu. [After Pl. XXI,3 in: John Hoffmann and Arthur Van Emelen, 1990, *Encyclopaedia Mundarica*, Vol. XVI]

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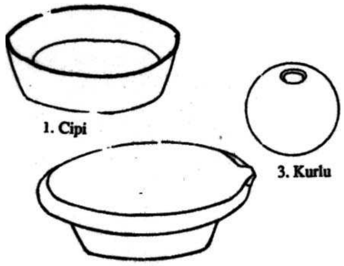
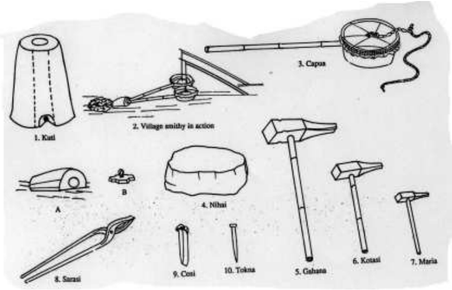
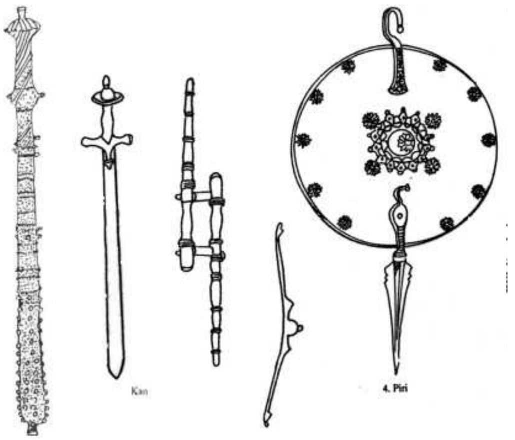


1. Cipi; 3. kurlu; 5. Dia [After Pl. XXV, in: John Hoffmann and Arthur Van Emelen, 1990, *Encyclopaedia Mundarica*, Vol. XVI]

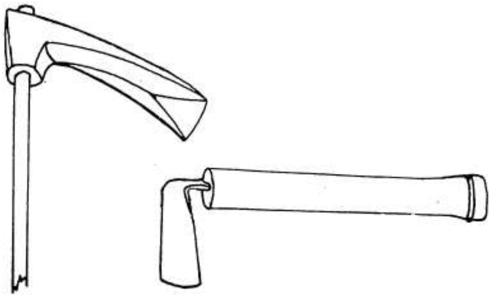
Holad.



Smelting furnace, implements of blacksmiths: 1. Kuti; 2. Use of bellows; 3. Capua; 4. Nihai; 5. Gahana; 6. Kotasi; 7. Maria; 8. Sarasi; 9. Ceni; 10. Tokna [After Pl. XXVI, in: John Hoffmann and Arthur Van Emelen, 1990, *Encyclopaedia Mundarica*, Vol. XVI]



Dancing (Paiki = sword dance) implements and weapons: 1. Susun-sota; 2. Susun-Kanda; 3. Tela-sota; 4. Piri [After Pl. XXX, in: John Hoffmann and Arthur Van Emelen, 1990, *Encyclopaedia Mundarica*, Vol. XVI]



Kurpi

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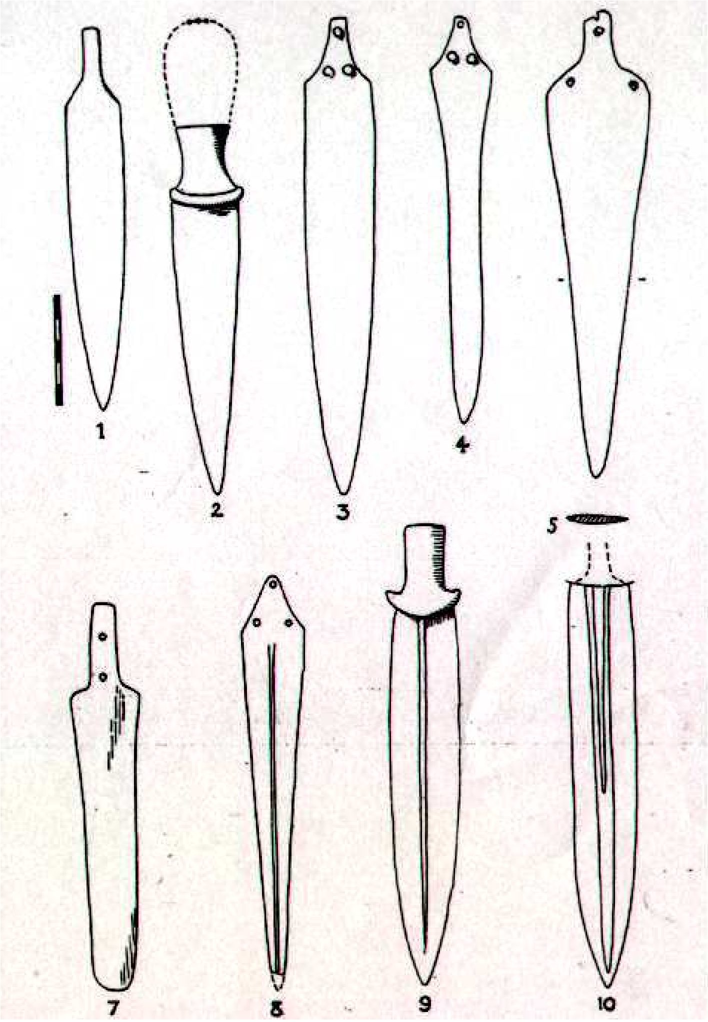
Bronze age artifacts in areas neighbouring Sarasvati Civilization



Types 1.5, 7.10 Daggers and swords; Type 1. Tepe Sialk. Ghirshman, Fouilles, I, pl. LXXXV, S.127; Type 2. Ur. Woolley. Royal Tombs, pl. 228, U. 9121; Type 3. Ur. Woolley, op cit, pl. 228, U. 9117; Type r. Ur. Woolley, op cit, pl. 228, U. 8108; Type t. Soli, nr. Mersin. Luschan, Globus, LXXXII (1902), 297,3; Type 7. Not illustrated; Type 7. Chagar Bazar. Mallowan, Iraq, IV, 2 (1937), Fig. 13,4; Type 8. Ur. Woolley, Royal Tombs, pl. 228, U. 8140; Type 9. Ur. Woolley, op cit, pl. 228, U. 14222; Type 10. Ur. Woolley, op cit, pl. 228, U. 12479.

Type 1. This is the most primitive form of western Asiatic dagger, but until the blade was strengthened by thickening or a midrib down the centre and rivets were introduced, it cannot have been a very efficient weapon, and must often have buckled upon impact...The dagger from Tepe Hissar, however, shows traces of the V-shaped overlap of hilt and blade. It is interesting that this type, which first appears in those levels of Tepe Hissar and Tepe Sialk when smiths were beginning to cast in an open mould, was not confined to the Prehistoric period, and than an example from Nuzu is dated as late as the Third Dynasty of Ur or First Dynasty of Babylon. In western Asia the geographical distribution extends to Persia, Turkestan, the Assyrian Eastern Provinces, Babylonia , Asia Minor, the Caucasus, and Cyprus and it seems probable that on the Asiatic mainland the type originated in the highlands of Persia and spread to the river valleys in the Jemdet Nasr period or earlier when the inhabitants of this area became acquainted with the technique of metalworking and were able to obtain supplies of copper from the Zagros mountains or Cilicia...In the early third millennium the remarkable similarity of metal types all over western Asia suggests that smiths in different areas were in close

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contact with each other and that there must have been a centre situated in a metalliferous area where the smiths could learn their trade, and then once the technique was mastered could return home and invent local types. Cilicia, with its long tradition of trade in metal and metal objects, has been suggested by Smith (Early History of Assyria, 57 ff.) , while Frankfort (Archaeology and the Sumerian Problem) has stressed the importance of the Caucasus as a metallurgical centre in the Early Dynastic period.

Against this view Jessen (A.A. Jessen and B.E. Degen-Kolvalevski, Iz Istorii Drevney Metallurgii Kavkaza, Moscow, Leningrad, 1935. English summary in Georgica, 1937, nos. 4 and 5, pp. 312 ff.) in his study of the ancient metallurgy of the Caucasus (in view of the fact that there is as yet no evidence that Caucasian copper ores were being worked as early as the first half of the third millennium, although this is probable), believes that it cannot be strictly established that the earliest metal objects found in the Caucasus were produced locally, and that it is not until later, in the second millennium, that the district attained its full importance as a centre for metalworking. The fact, however, that simple tanged rivetless daggers are found in the Kuban-Terek region at Novosvobodnaya (Carskya), Konstantinovka, and Privolnoe is not surprising in view of the widespread distribution of this type alll over the Near East, and Childe, in his summary of recently published Russian evidence, concludes that the foundation of a local school of metallurgy in northern Caucasia begins in Period II (Schmidt's Middle Kuban period, ca. 2300-1600 BC0, when 'hammer-pins and other ornaments decorated in cire perdue in imitation of filigree work, narrow flat celts and flat rivetless daggers' are found. The extent of Mesopotamian influence on the Caucasus region in Period I is difficult to determint, but the available evidence suggests that it undoubtedly existed in or soon after the Early Dynastic period. A final solution mus tawait the results of further excavation, especially in the Kuban region.

"Type 2. Flat blade, pointed; slightly convex sides; tang with one, two or three rivets. This type represents an improvement on Type 1. Whiel the blade remains leaf-shaped and only slightly curved in section, the rivets in the tang ensured that the hilt and blade remained securely fastened together when the weapon was used in combat...On the Asiatic mainland most of the examples date from the Early Dynastic period, and there are many examples from Cyprus dating from as early as E.C.I (ca. 2700 BC), but the type remained in use until the middle of the second millennium. On the present evidence it seems to hae died out in Babylonia after the Sargonid period. Yet this form of dagger, which must have been evolved by an Asiatic craftsman in Early Dynastic times, is found later in Syria, Phoenicia and even Asia Minor as well as in Persia and the Assyrian Eastern Provinces...The popularity of this type of Asiatic dagger in Egypt during the Hyskos period, coupled with its occurrence in a Hyskos context at Ras Shamra, shows that the metalsmiths working in Egypt were not averse to copying a common Asiatic form which remained in use alongside the more elaborate types which belong to the Hyksos period in Egypt...

"Type 3. Flat balde; slightly convex sides; three rivets; shoulders sloping to narrow tang. In this type the arrangement of the rivets shows an attempt to ensure that the blade did not break off from the tang on impact. The tang is therefore shorter than in Type 2, and the blunt point on some of the extant examples may be due to lack of sharpening or, alternatively, may show that the blade was used as a tool where only a sharp cutting-edge was needed...Like Type 2, it is probably Sumerian in origin, and subsequently spread into Palestine, Syria, Phoenicia and Cyprus. As yet no examples are known from Persia or Asia Minor...

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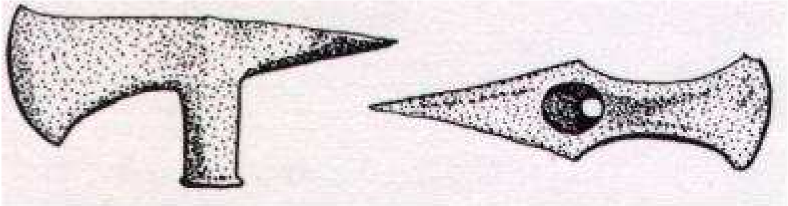
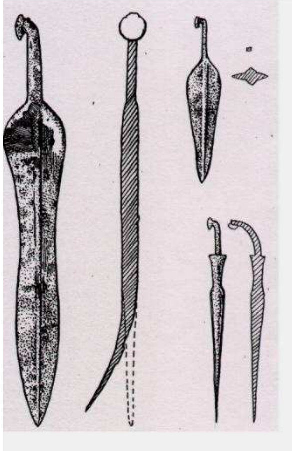
Type 8. Pointed blade with curved shoulders; straight sides; triangular-shaped tang with three rivets; raised midrib down centre of blade. This is a technically advanced type, as is shown by the strong midrib, the arrangement of the rivets, and the straight sides. Typologically it is a logical development from Type 3. There would be no danger of the blade buckling on impact, and the leaf-shaped blade forms which may have sometimes proved a disadvantage (owing to the difficulty of withdrawing the weapon quickly) were discarded in favour of this narrow straight-sided form...As yet there are few extant examples of this type of dagger in western Asia outside Sumer...the fact that the Sumerian examples are probably earlier than the Cretan need not lead one to suppose that the idea originated only in Sumer...

"Type 9 and 10. Leaf-shaped blade; single or multiple ribbing down centre; bronze guard, separate from the blade which is socketed to take the wooden handle. Standard Royal Cemetery type, including most of the gold examples.

"The leaf-shaped blade was also strengthened by a midrib or longitudinal blood-rills and on present evidence Type 9 seems to have been more popular in western Asia than the straight-sided Type 8. The earliest examples of Type 9 are from Babylonia, and the type probably spread into Iran at the end of the third millennium, where it later developed into a short sword.""(Maxwell-Hyslop, Rachel, Daggers and Swords in Western Asia, in: *Iraq*, Vol. VIII, 1946, pp. 1-65).





Tepe Hissar; from the 'Burnt Building' in level IIIB, ca. 2000 B.C. after Schmidt; combination of the basic forms of an axe and adze produced the axe-adze. Similar instrument was found in the reign of Shalmaneser III, ca. 850 B.C. Typical trough-sprouted vessels found at Tepe Hissar are similar to the types used in the karum at Kultepe in Cappadocia. Use of lead vessels is also paralleled in Kultepe, ca. 1900 B.C. [Kultepe is the place in Anatolia, with tin mines, see Yener's notes.]

Hissar III B dated a little before 2000 B.C. yielded the skull of a horse; the horse was domesticated at Shah Tepe much earlier, thus long anticipating the first appearance of it at Boghazkoy in Central Asia Minor in the early Hittite period. (Mallowan, p. 123).

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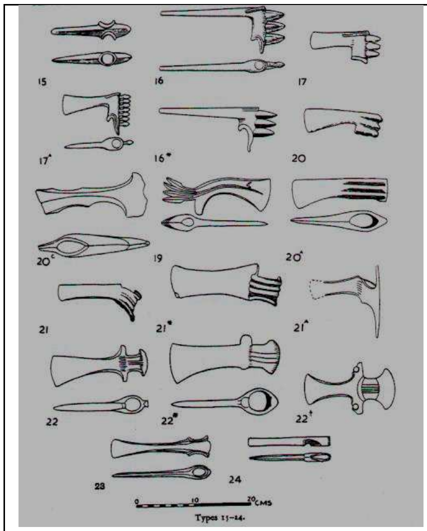
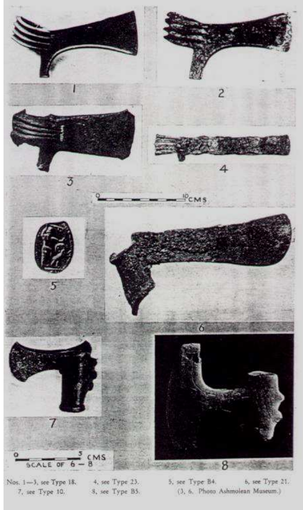
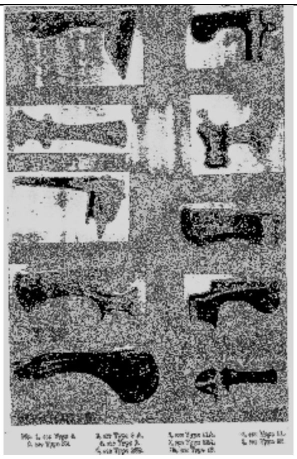
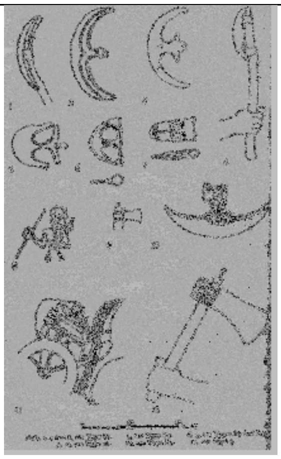
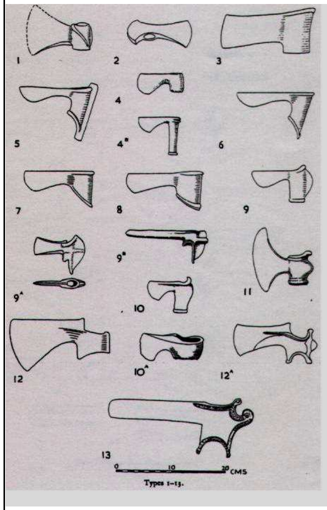
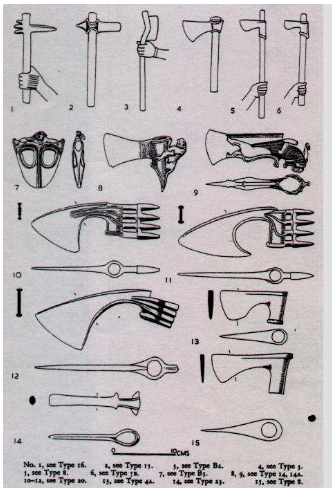
 West Asia axes, Plate XXXIV	 West Asia axes, Plate XXXVII	 West Asia axes, Plate XXXVIII
 West Asia axes, Plate XXXIX	 West Asia axes, Plate XXXV	 West Asia axes, Plate XXXVI

Tepe Hissar, ca. 2000 B.C.: spears with medial ribs and ridge-stopped tangs (Mallowan, Ill. 133) Tepe Hissar yielded gold, variegated jewellery, copper and silver vessels, many varieties of beads, among them much lapis lazuli; perhaps, Hissar was an entrepot in trade with taking the stone from the mines of Badakhshan.

Spears with medial ribs have parallels from Carchemish and Ugarit in north Syria dated a century before 2000 B.C. Such spears do not appear to occur in Mohenjodaro or other Harappan sites

(Plates from: Rahel Maxwell-Hyslop, Western Asiatic Shaft-hole axes, in: *Iraq* XI, 1949).

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"...there are few reliably dated examples and the fact that many types of bronze axe remained in use over several centuries shows how unwise it is to attempt to date these axes by typological analogy.. The question of craftsmen's guilds also needs consideration and many isolated examples of certain types can almost certainly be explained by the activities of individual members of these guilds travelling along the Asiatic trade routes. In the ancient East presumably the same conditions were enjoyed by metalsmiths as to-day are found among the Sulaba_, the travelling blacksmiths of the desert who are granted a certain immunity by the Beduin and can trespass on tribal land on account of their useful activities. If in periods of invasion and war metalsmiths were the only people able to travel easily, this may explain the curious distribution of some of these types of metal axe.

"It is clear that the vexed problem of the Luristan axes cannot be solved until many tombs containing axes associated with material than can be closely dated, have been properly excavated and recorded. In the vast amount that has been written on Luristan bronzes there is still extremely little dating evidence evidence, and in this study I have attempted to relate certain Luristan axes to those Asiatic types of which stratified samples exist...

"Simple shaft-hole types: Type 1 Shaft-hole axe with wide splayed blade and cutting edge parallel to the shaft; Babylonia: Jamdat Nasr (Mackay, pl. LXXV, Jamdat Nasr period (ca. 3200-3000 BC), Al'Ubaid (Childe, in ESA, IX, Fig.3. Painted clay model. Early Dynastic Period (ca. 3000-2700 BC), Eridu (RLA, 2, Taf. 63, Clay model), Lagash (De Sarzec, Decouvertes en Chaldee, Pl. 45, 6. clay model. Early Dynastic period (ca. 3000-2700 BC), Ur (Woolley, pl. 223, U. 15314, Early Dynastic III Period (ca. 2700-2400 BC); Anatolia: Bogazkoy (Przeworski, M.A., Taf. XI,4) (Plate XXXIV, 1) The technique of casting a single axe blade with with a vertical socket for the shaft made in one piece with the blade must have been known as early as the Al'Ubaid period, although there are no metal socketed axes of this period extant. But we have models from Al'Ubaid and Jamdat Nasr and these show that smiths could produce a simple type of shaft-hole axe with an oval-shaped socket and a wide straight edged blade. Round sockets are found on double axes of stone from Al'Ubaid levels at Arpachiyah and on a clay model of an axe, probably of stone, from the site of Al'Ubaid itself. The primitive shaft-hole form with oval-shaped socket is confined to Babylonia and the only example outside this area comes from Bogazkoy (Plate XXXIV, 1)

"Type 2 (Anatolia: Ahlatlibel. T.T., II. Ab.354 and 383. Bittel in A.F.O., XI, 12936, Fig. 7, pl. 2)(Plate XXXIV,2). In Anatolia the earliest metal shaft-hole axes are two copper examples from Ahlatlibel which have been dated by Bittel to ca. 2500-2000 BCE. The blade has convex sides and splayed cutting edge and is pierced by an oval shaft hole. There is no attempt to extend the socket down the shaft and the butt of the blade is curved and could have been used as a hammer. It is not a form well suited for casting in metal and the smith must have had a stone prototype in mind. In the Early Dynastic and Sargonid periods in Babyloina the socketed bronze axe along with the bow and lance became an important weapon of war and the simple form with rectangular blade set at right angles to the shaft hole, as well as the more advanced types 5,6,7 and i (Plate XXXIV, 5-8) is known not only from extant examples, but also from reliefs. The enemies of the Akkadians, the Lulubu, inhabitants of the Zagros mountain sused the same kinds of axes and the products of Akkadian metalsmiths must have been fairly common among the Eastern tribesmen. The two Luristan examples catalogued below may both belong to the Akkadian period and it is worth noting the figure on the rock relief at Darband i

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Shaikha_n, near Ho_re_n at the foot of the Zagros mountains who uses a curious weapon (Plate XXXVI, 4), with wide splayed blade and heavy moulding round the shaft hole edges...we know that Akkadian smiths could make shaft-hole axes which were used in warfare as the Lagash relief shows Type 3 carried by a soldier, and at the time of the Third Dynasty of Ur, this type was used again as is shown by the Ur Nammu stele from Ur...Reliefs from Ashurnas.irpal's palace at Nimrud shows the type with blade set at right angles to the shaft and no shaft tube for the socket. It is carried on the king's chariot as a hunting weapon (see Plate XXXVII, 11). But while the Elamites are portrayed fighting the Assyrians with socketed axes, for the Assyrian soldiers the axe was not as important a weapon as the short sword and was used more as a pioneering tool by the Assyrian charioteers who carried it in their weapon carriers. An interesting example comes from Luristan now in the Savory collection (Archaeologia, 88, pl. LXXII, 5). This is a heavy, well-made axe, certainly not made for ceremonial purposes but for use, and Przeworski has suggested that it may be the prototype of the Tall Sifr example. (British Museum, Bronze Age Guide, Fig. 186). The Tall Sift hoard has been dated to many periods from 2000 BCE to 1200 BC, but a date in the Early Dynastic III or the Third Dynasty of UR period is more probable. The weapons are all copper and an adze is very similar to an example from Luristan, now in the Brussels Museum, inscribed with the name of Gimil-sin of the Third Dynasty of Ur. Another axe from Sippar, now in the Brussels Museum, is an interesting, though unstratified example of this type with clearly marked mouldings rond the base of the socket (Plate XXXVIII,6).

Type 3. The blade is long and rectangular in shape and in most examples the socket does not protrude below the level of the lower edge of the blade. Babylonia: Ur (Woolley, pl. 223. U. 11915. Early Dynastic III period (Plate XXXIV.3); Ur (British Museum, No. 118054); Lagash (Sarzec, Dec. en Chaldee, pl. 5 bis. Relief. Sargonid period); Sippar (Brussels. Musees Royaux. No. 0350. Plate XXXVII,6). BMAH, May 1932, p. 61); Tall Sift (British Museum Bronze Age Guide, FIg. 186; Guide to the Iraq Museum, pl. XXIV, IM. 10776); Iran: Luristan (Przeworski, in Archaeologia 88, pl. LXXII, 5. Savory collection); Luristan (BMAH, Jan-Dec. 1946, p. 3, Fig.u); Susa (DPM, I, Fig. 263); Naram-Sin stele (Contenau, Manuel, II, Fig. 469, Sargonid period (ca. 2400-2200 BC); Darband i Shaikha_n nr. Ho_re_n Rock relief (Contenau, Manuel, I, Fig. 47 (Plate XXXVI, 4).

Type 4. (Plate XXXIV, 4, 4b; Plate XXXVI, 13; Plate XXXVII,2). The top of the balde and socket in a straight line: the lower edge of the blade is cut away leaving a narrow width between the junction of socket and blade. (Iran: Tepe Khazineh: DPM, VIII,Fig. 308, Early Dynastic I period; Luristan: Cambridge, Museum of Archaeology, Nos. 34, 910: Plate XXXVI, 13; Tepe Giyan: Contenau, pl. v, 4. Level IV, ca. 2300-2000 BC). The edge of the blade was curved and this shifted the point of impact on the cutting edge. Early examples of this occur in tombs in the Musyan region; the Tepe Khazineh example is associated with 'Scarlet ware' and therefore should belong to the Early Dynastic I period (Plate XXXIV, 4). Metal is not common in these tombs but while the stratification is uncertain, when this example is compared to dated Early Dynastic III types, it seems likely that it should belong to the earlier period. Other examples and variants also from Iran where the type has a long history. Tomb 104 at Tepe Giyan has yielded a similar axe with a slightly longer shaft tube which belongs to Level IV and may be dated to about 2300-2000 BCE.

Type 5, 6, 7 and 8 (Plate XXXIV, 5-8; Plate XXXVII, 1; Plate XXXVI, 5, 6, 15). Type 5: socketed axe with cutting edge on under side of blade and flange at outer edge of socket (Babylonia: Ur. Woolley, pl. 223, U. 1187. Early Dynastinc III period; Woolley, pl. 223, U. 8065. Early Dynastic III period; Kish. Mackay,

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Part II, pl. LXII, 1. Early Dynastic III period; Ur. Woolley, pl. 223, U. 11701. Early Dynastic III period; Stele of the Vultures: De Sarsec, Decourvertes en Chaldee, pl. III, bis. Plate XXXVI, 6; Early Dynastic period; Ur. Woolley, pl. 223, A. 2b. Early Dynastic III period) In the Early Dynastic III period, Sumerian metalsmiths developed the socketed axe from the simple Type 3 and by the time Ur cemetery were producing welll-made, technically advanced models in bronze, gold and electrum. Earlier examples at Ur were probably cast in a two-piece mould and the flange on the outside of the socket gave added strength to the shaft. Typologically later types do not show this flange but keep the feature of the tubular collar at the top and bottom of the socket. On the Stele of the Vultures, Type 5B with the flange is shown as well as TYpe 8 (see Plate XXXVI, 5,6). In Types 5 and 6, the cutting edge was on the underside of the blade which was set at an acute angle to the shaft. When compared to Type 3 the effectiveness of these blades seems doubtful, yet they are portrayed on the Ur standard, as carried by Sumerian soldiers and therefore must have been used for warfare. In Types 7 and 8, the cutting edge is shifted to the front of the blade; the shaft hole is broader and Type 8, as shown on the Stele of the Vultures (Plate XXXVI, 5) and the Ur standard, is obviously a serviceable weapon. Important stratified examples of Type 8 come from Til Barsib. Examples of Type 6 from Tepe Ali Abad, near Musyan, are of Early Dynastic date and the unstratified Luristan axes of Type 6 have exactly similar blades and sockets. The Susa example of Type 8 is important for dating purposes. It was found inside a copper vesel with two adzes and a flat axe blade in a level which can be dated with fair certainty to the Third Dynasty of Ur period. The Cambridge Luristan axe (Plate XXXVI, 15) is almost exactly similar and it is unlikely that these Luristan axes and the Iranian example from Kirmanshah (Type 7) are much later than 2100-1900 BCE.)

Crescent axes, e-shaped blades and balberds (Plate XXXVII, 1-4, 8). The simple curved blade found at Ur (Plate XXXVI, 1) in the tomb of Queen Shub-aid, can be regarded as the earliest form of both the curved sword or scimitar and the crescent axes and e shaped blades. This blade was fixed to a wooden handle by a rivet driven through the handle at either end and by a band of gold which passed round the handle and was rivetted to the centre of the blade. An inlaid plaque from Kish shows this weapon held by the king in his left hand (Mackay, Part I, Pl. III). In its more developed e shaped form the blade is practically semicircular and has a definite projecting central tang. When riveted to the wooden shaft, two openings would result and this characteristic is found on all the latter axes of this class. Both the e shaped and crescent axes were evidently important weapons of war. A relief discovered at Ur (Smith, Early History of Assyria, Pl. 5, p. 73) certainly contemporary with or earier than the First Dyansty of Ur shows two e shaped axes of developed type in the weapon-carrier of a chariot and later Sargon of Akkad's soldiers use the simpler form (Plate XXXVI, 4). In this style, the axe is portrayed in Egypt on a Predynastic stone vase and was later used in the Twelfth Dynasty period (Scharff, Die Altertumer der Vor-und Fruh-zeit Agyptens 2, Taf. 22, N. 108)...Evidently the idea of making this axe with a socket was of Asiatic origin as on a Twelfth Dynasty painting, where Egyptians carry blades of this type hanted into the handle; the Syrians in the same scene carry a socketed axe (cf. Petrie, T.W., pl. VI, 173).

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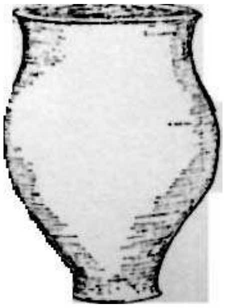
Bharat, Hurrian, Mitanni

Gordon Childe points to the parallels between Mesopotamian and Harappan cultures. There are references in Hurrian and Mitanni texts to the cultural traditions of Meluhha and later, Bharat which are elaborated in the context of warfare described in the Mahabharata – with particular reference to the ratha, horse-training, arms and armour.

Mesopotamia and Harappa

The wolf in the second panel has a dagger tucked in the belt. The bottom panel shows a scorpion-man being offered two vases by an antelope. Shell inlay from Royal tomb at Ur. In: V. Gordon Childe, 1929, *The most ancient east: the oriental prelude to european Prehistory*, New York, Alfred A. Knopf.



Copper beaker from Harappa [V. Gordon Childe, 1929, *The Most Ancient East: the oriental prelude to European prehistory*, London, Kegan Paul, Trench, Trubner and Co. Ltd., Fig. 86]. 'Vessels were made of copper, silver, shell, and pottery...One silver vase is cylindrical in shape, while some copper vases resemble tall beakers with narrow cupped bases and splayed out lips. The pottery types include many similar beakers, great elongated piriform jars with very narrow bases and well-formed necks. Some craters stand on pedestals.' (Childe, opcit., p. 207).

'The Indus and Sumerian beakers have an unmistakable family likeness. The cylindrical vase of silver from Mohenjo Daro invites comparison with the alabaster vessels of the same shape from Ur and Susa.' (Childe, opcit., p. 211).

Copper dagger and chisel, Harappa [V. Gordon Childe, 1929, *The Most Ancient East: the oriental prelude to European prehistory*, London, Kegan Paul, Trench, Trubner and Co. Ltd., Fig. 85]. 'Some of the chisels broaden out a little below the butt, the sides then contracting only to splay out again at the blade.' (Childe, opcit., p. 207).

'The daggers from Harappa, again, belong to the same tanged family as the Sumerian, but to a more primitive stage.' (Childe, opcit., p. 211).

'As a counterpart to the Babylonian constructional methods and artistic motives appearing in Egypt we now have the sistrum (fron an early tomb), the funerary barque, the chamber tombs and the alabaster vases...on the same inlay as the sistrum appears Gilgamesh and on the very same panel a bear! We are dealing accordingly with intercourse between two mature cultures...In any case in material progress and wealth Sumer was far ahead of Egypt. The latter country lacked, for instance, the finer types of metal tool, such as the socketed axe, and wheeled vehicles, and no Egyptian jewelry anterior to the Third Dynasty can compare either for sheer wealth or artistic merit

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and technical excellence with that of Shub-ad...The native genius of the people who could invent writing and wheels and harness the ox and the ass will doubtless explain very much...Perhaps the dynasts who concentrated wealth and power in the cities were foreign conquerors...The first prosperity of Sumer was bound up with Indian intercourse.

'The regularity and intimacy of the intercourse with India is proved by the occurrence on Sumerian sites of objects imported from the Indus Valley, the oldest indisputable instances in the world of manufactured goods of precisely defined provenance being transported for long distances from the centre of their fabrication. At Umma, Lagash, Ur, and Kish, in the last two instances in pre-Sargonic deposits, have been found rectangular stamp seals of steatite, in some instances glazed, which agree precisely in shape, material, and design with those found in great abundance in the ruins of prehistoric cities in the Indus valley. Then in the archaic tombs at Kish Mackay found beads of cornelian etched with patterns by an elaborate process. Such beads, to which Ur has now yielded parallels, are in Mesopotamia confined to this one period, but in India they are common and enjoyed a long popularity. Finally from 'Ubaid come fragments of vases made from a rock, identified as the 'pot-stone' which is used still in India for the manufacture of vessels. The survival of such scraps is some indication of the liveliness of commercial intercourse between the two distant lands.

'It has, however, been suggested that this intercourse denotes more than trade. The popularity of mother-of-pearl as a material for inlays connects the Sumerian civilization by one of its most fundamental traits with the south. The legend of Oannes who came up the Persian Gulf to found the first Sumerian city at Eridu and the Sumerian location of paradise in the south point in the same direcdtion. Those who believe that the kaunakes was a palm-leaf skirt can cite the use of a similar garment in modern India and above all its association with the pre-Aryan godess Parnas'avari. Dr. Hall has drawn attention to the resemblance of the Sumerians as represented in their statuettes to the Dravidians of India. And now the discoveries on the Indus have revealed a civilization still more advanced than that of Mesopotamia before the middle of the thrid millennium; there many of the distinctive elements of the Sumerian's cultural superiority existed in a still more developed form.

'Do the trade relations attested about 3000 BC, just continue older ethnic relationships? Were the higher elements of Sumerian culture inspired by India? Did the Sumerian themselves as a conquering minority bring those devices to Mesopotamia?' (Childe, opcit., pp. 196-199).

'The bow was probably already of the variety known as composite; in any case some bows were bound with gold asnd the ends were tipped with curved pieces of copper to which the string was attached. The arrow-heads were normally of metal and leaf-shed, sometimes barbed or four-sided; most are tanged but some have tubular sockets formed by folding the beaten copper. However, one bunch of arrows from the tomb of Mes-kalam-dug at Ur had been tipped with chisel-bladed heads of flint. These were based upon the trapeze, but the edge opposite the blade has been narrowed down into a sort of tail. The shafts were reeds often equipped with little metal prongs, like the spear-butts on a smaller scale, to replace the notch.(Childe, opcit., p. 181`).

'At the one site, Mohenjo Daro in Sindh, no less than ten superimposed cities have been identified, though only the three latest have hitherto been explored. The parallel site in the Punjab, Harappa, was apparently abandoned sooner and the material gathered there is on the whole older than that reached further south. But the high antiquity of the Indus civilization is proved in other ways. Our material is derived from vast cities with regular streets, houses, and temples. But not only is the civilization thoroughly urban, its authors have dwelt in towns so long that they have devised amenities, such as drains and baths, the necessity of which was only recognized in relatively modern times.

'...the alabaster statuettes depicting a type not unlike the Sumerians with prominent nose, thick lips, and receding forehead. The hair was worn long done up in a bun at the back of the head,

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exactly as in Sumer. The upper-lip alone was shaves, a short chin beard being allowed to grow. A patterned shawl was worn over the left shoulder and under the right. A kilt or skirt was draped round the loins like the Sumerian kaunakes...And true cotton was grown for the manufacture of textiles...

'(Cities) were regularly laid out with streets, temples, and baths. The universal building material was brick, the bricks being thin and biscuit-shaped (11 in. by 5.5 in by 2.75 in., or 17 in by 8.5 in. by 3 in. at Mohenjo Daro) but kiln fired and set in genuine lime mortar. Bitumen was used as a damp-course in drains and baths. Stone was perhaps used for pillar bases. But wood was employed for floorings as well presumably as for roofs...drains were covered over with a corbelled vault. In one or two external walls niches two to three feet wide and nine inches deep were used decoratively just as in Babylonia.

'Naturally such a civilization subsisted on trade. Copper was imported from the neighbouring highlands to the east or the west, tin from Khorasan or Burma, shells and fish from the sea coasts, bitumen perhaps from Mesopotamia. This trade was facilitated by a system of writing which was still partly pictographic. The signs are found stamped on copper bars or engraved on seals that served to authenticate documents which have perished. A system of weights was recognized which differed from the Babylonian.

'...a copper model from Harappa depicts a two-wheeled cart with a gabled hood over it. Navigation, at least on the Indus, is presupposed in the evidently regular intercourse with the coast.

'The urban artisans were expert in working metals, principally by hammering but also to some extent by casting, and could even make an alloy of copper with from 6 to 12 percent tin. The crafts of the potter, weaver, goldsmith, and jeweller were no less flourishing. Moreover the secret of producing glazed fabrics had been mastered, and beads and larger articles were made of a blue encaustic fayence.

'None the less even in the cities metal had by no means ousted stone tools; chert was used for spheroid mace-heads. At the same time copper was employed for the manufacture of many tools and even for vessels of considerable size and was alloyed with tin where a specially durable edge was required as in razors. Few types have yet been published and the number of weapons is particularly small. We may note here long flat axe-heads and adzes (celts), narrow chisels, tapering daggers with pointed tangs but no rivet holes and straight backed saws with a convex blade. Some of the chisels broaden out a little below the butt, the sides then contracting only to splay out again at the blade...

'The large tanks are supposed to have been connected with temples, that no doubt existed at points where later sanctuaries now stand. Female figurines of clay are quite common and may be votives denoting, as in Babylonia, the cult of a Mother Godess. Of great importance is a fayence plaque representing a female deity sitting cross-legged between two serpent-votaries in attitudes of adoration. There are, moreover, hybrid figures engraves on the seals that have been compared to the Sumerian monsters of the Gilgamesh cycle...In any case the cross-legged deityh between serpent adorants directly anticipates a well-known theme of Indian iconography, and on the seals the pipal-tree is already represented as an object of sanctity...' (Childe, opcit., pp. 203-206, p. 209).

'What looks like a provincial variant of the same culture is coming to light at Nal in the Zhob valley, and at other sites in the hill countries of Baluchistan and Waziristan. But even here the houses were of brick, and boasted several rooms. Though flint implements are more numerous than in the plains, copper was used at Nal too. Axes, adzes, chisels, and daggers, all of the Indus type, have been found, and even copper vessels have come to light...Fractional burials represented at Mohenjo Daro by one example only, were quite common at Nal, though cremation and total interment in the contracted posture were also practices.' (Childe, opcit., p. 21).

Stone vase carved with procession of animals, Erech. [V. Gordon Childe, 1929, *The Most Ancient*

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East: the oriental prelude to European prehistory, London, Kegan Paul, Trench, Trubner and Co. Ltd., Plate XX]. 'Among the Sumerian vessels of gold, electrum, silver, copper, alabaster, obsidian, lapis lazuli, and ostrich-shell had ousted fine pottery from the tables of the wealthy, while the friezes of animals painted on the prediluvian clay vbases have been replaced by the processions carved on low relief on the stone vessels.' (Childe, opcit., p. 181).

Circular bas-relief showing a hunt in the marshes. [V. Gordon Childe, 1929, *The Most Ancient East: the oriental prelude to European prehistory*, London, Kegan Paul, Trench, Trubner and Co. Ltd., Plate XX b.] Note the harpoon. 'The harpoons used in fishing were chisel-ended and single-barbed. They look like metal versions of the tyupe formed by setting a flint lunate obliquely at the end of a reed.' (Childe, opcit., p. 181`).

Golden dagger with lapis handle and its sheath, Ur [V. Gordon Childe, 1929, *The Most Ancient East: the oriental prelude to European prehistory*, London, Kegan Paul, Trench, Trubner and Co. Ltd., Plate XIX a.] 'The daggers have flat ogival or long triangular blades strengthened witha midrib and extended by a tang projecting from the base. The shoulders are square or steeply sloping. The hilt of wood or lapis lazuli were rivetted to the tan by one, two, or three rivets; the junction of hilt and blade was sometimes covered with a carefully shaped ferrule. This often overlapped the blade, but never curved round it as in early Egyptian specimens, so that the meeting point of blade and hilt formed a straight or even line convex, never a semicircular indentation. For sharpening the dagger warriors carried whetstones suspended from the belt by a ring passing through a perforation at one end.' (Childe, opcit, pp. 179-180).

Sumerian dagger blades, Kish A, and poker-butted spear-head, Ur [V. Gordon Childe, 1929, *The Most Ancient East: the oriental prelude to European prehistory*, London, Kegan Paul, Trench, Trubner and Co. Ltd., Fig. 75] 'The spear was no less typical than the axe in Sumerian armament. The majority oif the actual specimens (of spears) have lanceolate or poker-shaped blades and rectangular tapering butts (whence the name poker-butted spear-head). The butt fitted into a reed shaft which was frequentlyh strengthened with a metal ferrule or casing. Some of the throwing spears were hurled with the aid of a sling. They are accordingly provided with little forks of metal to servfe as notches. Cones of sheet copper perforated with rivet-holes may represent the butt-pieces (sauro_te_rs) of the pikes.' (Childe, opcit., p. 179).

'The Sumerian army as illustrated on an inlay recently discovered at Ur included both charioteers and infantry. The chariots were manned by a warrior and a driver. The charioteers were armed with spears of two types, one designed for throwing, the other for in-fighting. These weapons were carried in a special receptacle, apparently of basketry, in the front of the chariot. The footmen were divided into skirmishers armed with arrows and heavy pikemen who fought in the phalanx, anticipating the Macedonians by three thousand years.These were protected by copper helmets and wore in addition to the kaunakes a cloak of some spotted material hung over both shoulders and fastened at the throat.' (Childe, opcit., pp. 176-177).

'The implements of the protohistorical period were almost entirely of metal which had practically ousted stone in the urban centres. The chisels were long and flat, often with a pointed triangular butt. As a new tool appears the bronze saw. It was equipped with a tang for the handle, and the serrated blade curved away slightly from the base. By this date too the 'jaw-bone' sickle had been translated into metal, and the type with a looped tang for handle is to be regarded as Sumerian...

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'The weapons include the battle-axe, the spear, the bow and arrows, the mace with pear-shaped head of stone, and a curious smashing weapon resembling a boomerang-club armed with a copper blade.' (Childe, opcit., p. 176, pp. 177-178).

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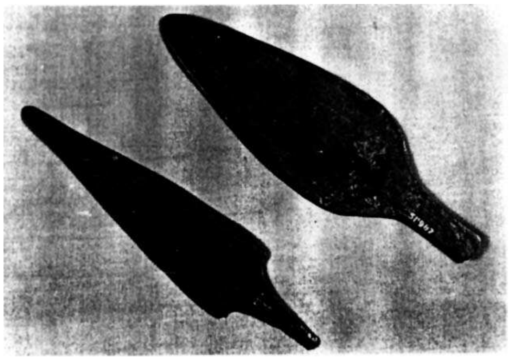
‘Vessels were made of copper, silver, shell, and pottery. One silver vase is cylindrical in shape, while some copper vases resemble tall beakers with narrow cupped bases and spayed out lip. (Fig. 86)…Harappa yielded an interesting toilet set. It consisted of a pricker, a narrow knife, and a pair of tweezers. The butt of each implement had been hammered out into wire, which was bent back and twisted round the stem to form a loop. This triad of interlaced implements forms an almost exact counterpart to the Sumerian reticules, and show that the idea of the knot-head was familiar on the Indus. Elaborate metal plugs made in two pieces were worn in the ears…The cylindrical vase from Mohenjo Daro invites comparison with the alabaster vessels of the same shape from Ur and Susa. The Sumerian and Indus toilet-sets are in principle identical, and each show the same peculiar construction of the looped head…Motives like the trefoil and the rosette, even religious themes such as monsters, are common to both countries. It is fantastic to suggest that the wheel and carts had been independently invented in both lands…fourth millenniu. Already the Arabian Sea was ploughed by dhows, freighted with the stuffs of Sindh consigned to Babylonian river towns.”(pp. 206-213).



Copper. Lid. 17 cm. Dia. 4 cm. Thick. E2044 Mohenjo-daro. Marshall, 131: pl. CXLII.2: Yule, 1985: 9, no. 64, tabl. 9.64. Yule, P., 1985. *Harappazeitliche Metallgefashe in Pakistan and Nordwestindien. Prahistorische Bronzefunde II.* 7. Munchen.

Haraqppa. Dagger with tapering blade and long tang. Sharpened along one edge and both edges at the tip. Found in a jar thought to be the hoard of a copper merchant. National Museum, Karachi NMP 54.271; Vats 1940: 87, pl. CXXIII,30. 17.9 cm. Long and 4.5 cm. Wide.

Cylindrical vessel. Bronze/copper. Mohenjo-daro. 13.5 cm. 12.5 cm. Dia. NMK 52.1022; DK 11 337. Mackay, 1938: 443, pl. CXVI.3; Yule, 1985: 11 no. 82. tabl. 12.82.

Plates. Bronze/copper. Harappa, Mohenjo-daro. 1. 4.1 cm; 24.4 cm. Dia; Yule, 1985: 5 no. 16, tabl. 6.16; Vats, 1940: 384, note 3; 2. 2 cm. 16.7 cm. Dia; Yule 1985: 8 no. 52, tabl. 9.52.

Bronze/copper cauldron. Harappa.16.5 cm. 25 cm. Max. dia. NMK 52.3214; Vats, 1940: 85.384. note 3.

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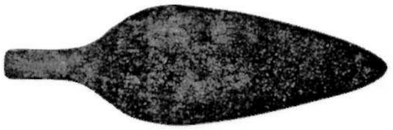
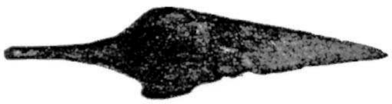
Bronze/copper. Mohenjo-daro. 28.3 cm X 7.2-10.8 cm. DK 7535. Mackay, 1938: 454, pl. CXXVI.5.



Spear-head. Mohenjo-daro? Bronze/copper. 18.6 cm. Long; 5.9 cm. Wide. NMK 51.987? Mackay, 1938: 459-60.



Spear-head. Bronze/copper. Harappa? 15.6 cm. Long; 4.4 cm. Wide. HM 13317? Vats, 1940: 383-6; Mackay, 1938: 459-60.

Razor. Bronze/copper. 21.4 cm. Long; HM 13.488? Mackay, 1938, pl. CXX.12

Rod. Bronze/copper. Mohenjo-daro. 24 cm. Long; 2 cm. Wide;

MM 140: DK 10 781.(1). Mackay, 1938: 473, 483, pl. CXIV.5

Axe-Blade. Bronze/copper. Mohenjodaro. 16 cm. Long; 6-9 cm. Wide; MM 132: VS 1450. Marshall, 1931: 229, 496, pl. CXXXVIII,6

Axe-Blade. Bronze/copper. 17.3 cm. Long; 3.8-5.3 cm. Wide; MM 136: DK 3469. Mackay, 1938: 455, pl. CXX.28

Settlements

“The largest, called city or town (nagara, pura), was an outgrowth of the village (gra_ma, khet.a), and is represented as walled; while the village is a collection of houses around a fort (durga). The village itself is often no more than the natural development of the ghos.a, or ‘cattle-ranch’, which the king is bound to have guarded, and seems to have converted in favourable places into a small village by erecting a fort

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like that around which the gra_ma naturally arose. With this ghos.a, and on a par with it, are sometimes mentioned the small barbarian settlements called *palli_ (palli_ghos.a_h*, xii.326.20)…

"There is no part of Hindu literature so old that walled cities are not mentioned in it. (Va_sis.t.ha Dharmas'a_stra ii.49; Gautama Dharmas'a_stra xvi.32)…Manu (of a king): 'He should live in a city fortified by a desert, by an earth (wall), by water, by trees, by men, or by a hill; but best of all, let him occupy a hill-fort (town set on a hill).'" (p. 123).

Arms of the Vedic and Epic ages

An army camp in ths Epic times was said to be located built near to the city wall (a_yudha_ga_ram vapra_ntam (i.147.13).

"The (army) camp itself (s'ibira or sena_nives'a) consisted of separated tents stored with arms. (Bows, bowstrings, corselets, swords, honey, butter, lac, fodder, arrows, axes, spears, quivers, besides ponderous machines, are prominent among the stores of the camp…Chariots, armed elephants, etc. are in all parts of the camp.) …Watch-words and secret signals by which friends may be recognized are given out before the battle begins (abhijn~a_na_ni or sam.jn~a_h, vi.1.11 ff.)…arsenal: sa_m.gra_mika and a_yudha_ga_ra are the usual terms. (pp. 136-137, p. 178).

"Comparing the Epic and the Vedic ages, we find in the Epic the arms of defense equally developed with those of offense, whereas in the Veda the former seem more deficient, not only in construction but also in number. The Vedic hero rides in a two-wheeled chariot, and his chief weapon (a_yudha) is the bow (dhanvan), not straight, but already bent before use. To this was added one string of leather (jya_), and the arrow (is.u), which was drawn not to the breast but to the ear…other national names are given: e.g. ba_n.a (reed); s'arya, later s'alya (dart). The left hand was already protected with a leather strap. The arrows were feathered, and often poisoned; tipped with horn or metal, and preserved in a quiver (is.udhi, nis.an:ga). Besides this, the warriors had spears (r.s.t.i), and, perhaps, short swords (kr.ti); while to heavenly powers the singers attributed ju_rn.i, perhaps lightning only; and the axe (paras'u), though not disdaining the throwing of rocks. In defense the Vedic warrior carried the 'defender' (varman): a word common to the Vedic and Iranic. This covered his shoulders, and was either made of metal wire or covered with metal, while for the head he carried a helm of several pieces…Such is the picture presented by the Vedic knight, the earliest Aryan warrior (Drawn from Zimmer's *Alt. Leben*, pp. 298 ff.) " (pp. 178-179).

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Epic Chariot

A ratha may be for war (sa_m.gra_miko rathah) or for peace (kri_d.a_rathah) (MBh. xiii.53.28).

"When two horses are sufficient, one sa_rathi or charioteer is sufficient also. In the case of four horses (two fastened to the pole, two by straps outside, not tandem: dhur and pa_rs.n.i), we have one charioteer in the middle, who guides the pole-horses, and on each side of him the two drivers of the outer steeds, pa_Rs.n.isa_rathi_…

"Parts of the chariot. Beaneath is he axle (aks.a), to the ends of which the wheels are attached, and above and before which is the charioteer's place, while above and behind is the place of the knight. The 'nest' or box is so intimately connected with the axle that the two are often broken together. (bhaganacakra_ks.ani_d.a_h, vi.71.32). The noiseless running of the axle is praised. (aku_jana_ks.ah (rathah) v.48.28 – Pa_n.in.i uses ku_jana of wheels)…The wheel consists, besides the wooden circle, of the tire (rathanemi, vi.117.54), the spokes (ara), and the hub (na_bhi). The 'place at the spokes' (ara_stha_na) was reserved for knights, high-born attendants of the king, 'who at the master's chariot did mighty deeds in the van.' (vii.34.14; xii.98.28: bhartu_ rathe ca yah s'u_ro vikramed va_hini_mukhe). The tire, which was also called 'fore-circle' (praman.d.ala), appears to be of iron, if we may judge from constant reference to the 'noise of the hoofs and the tires' (ix.9.14015)…The upastha (rathopastha) was the general bottom of the car; the ni_d.a (rathani_d.a) was the little shelf in front where the charioteer stood. (That the driver has a seat is indicated by the term bandhura or atibandhura [vii.96.31; iii.241.31) handed down from the Vedic age, here as the seat of the driver, while (if one exists) the knight's seat is called talpa (vii.192.68)]…

"The chariot gives the honourable title of rathin and atirathin to the knight. According to the opening of the war, the knights are classified as 'those that have chariots,' 'superior chariot-men,' 'very superior chariot-men,' etc. [These terms were also employed as proper names. Adhiratha, a_dhirathi, Atiratha (vii.134.13,11; viii.51.68; vii.132.6: 133.44), were at first those skilled in driving 'on the car.' Proper names are also made by forming ratha into the end of a compound, as Vr.karatha (na_ma bhra_ta_karn.asya), vii.157.21]…

"There appears…to have been a guard of some sort round the car in the Vedic period; and in the Epic we may probably translate the 'guard' (varu_tha) in this way, though it also means an over-shield…The 'pole of the car' (ratha-i_s.a_), or commonly the pole alone (ku_bara), is fastened to the box of the car (ka_s.t.ha), and to the double yoke (yuga) that crosses it, and (dhur) rests in turn on the necks of the steeds. (yugam.dhara – yoke-holder vi.1956C; dhur = load, either pole or half-yoke). The fastenings of the yoke (like the general cakrabandha, rathabandha) are termed yoktra, fastening yoke and pole, or sam.nahana, 'joiners,' and all appear to be of lelather, as do the reins (ras'mayah), and are gilded, so that they 'shine like the sun,' with the gaudy rest. When a distinction is intended, i_s.a_ is the lower, ku_bara the upper end of the pole…

"The standards and flags of the war-cars, dhvaja, ketu, pata_ka. These bear an important part in battle, for they are the rallying points of either party, and the standard of a great knight is well spoken of as the upholder of his whole army…Arjuna carried 'an ape with ferocious mouth and a lion's tail,' and had flags besides; Karn.a had a hastikaks.ya_; Dron.a, a steer; still others bore peacocks, boars, elephants, sometimes bearing bells of silver or of gold; and one knight has a silver boar in a gold net. (Arjuna has one sim.hala_n:gu_lam ugra_syam va_naralaks.an vii.105.8…The govr.s.a is S'iva's sign (vr.s.adhvajah); the boar, Vis.n.u's)…Karn.a is distinguished by a symbol called kaks.a_ or kaks.ya_: I think, a tiger…

Arms in a chariot

"The car…was an arsenal, holding a complete assortment of arms in large numbers…More specific is the account given in the following (viii.76.17): 'Six ayuta_ni of arrows, numberless darts, hammers, spears, knives, bhallas (also

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arrows) – which not even a wagon drawn by six cows could carry (s'akat.am s.ad.gavi_yam) – are here left under the care of one warrior. 'With darts (54.7, vis'ikha, vipa_t.ha; 29, pr.s.atka) and handguards, with quiver and horn and banner, with brest-plates, diadem, sword, and bow,' is the description of a knight in his car (iv.53.9)…A hundred quivers, besides clubs, s'ataghni_s, bells, spears, spits, darts, bows, are I a car with a varu_tha (viii.11.8)…

"[War-car]'Harness up (sajji_kuru ratham), the saint cried; prepare quickly thy chariot called the war-car, with weapons and banners, with a spear and a gold staff (yas.t.i), noisy with the sound of bells, furnished with ornamental doors (yuktas toran.akalpanaih, 31), gilded, supplied with hundred of arrows; this was done, and the king placed his wife at the left of the pole (va_me dhuri), and himself at the right, and laid within the car the goad, sharp-pointed, made of three sticks' (tridan.d.am vajras'u_cya_gram pratodam tatra ca_ dadhat) – for this was another naraya_na, and the king and his wife were forced to drag the car for a great saint. (sam.gra_miko rathah and kr_d.a_rathah, xiii.53.28 ff.)…

"…we find in a list of parts of chariots, besides those already discussed, the dan.d.aka, apparently equivalent to yas.t.i, the banner-staff; the jan:gha_, probably the aks.ajan:gha_ or 'axle-tree'; and das'ana, perhaps the spokes (unless the harness in general is meant)…

"The charioteer, su_ta, sa_rathi, yantar, niyantar, rathayanta_rau, pa_rs.n.iyantar, pa_rs.n.isa_rathi_, abhi_s'ugraha (viii.32.19), rathava_haka, rathin (abstract, sa_rathyam): the car held one or three charioteers…

The chariot-steeds

"The most popular war-steed is the horse (as'va, haya, turaga, rathava_ha, va_ha etc.). Mules were, however, often employed, and seem to be admired especially on account of their great speed. [Two best horses are reckoned equal to four best asses in making a bargain: iii.192.51]. Camels are used as steeds only in peace; elephants, only when ridden…The most famous horses come from the Sindh country or from Kamboja; of the people of the latter country the pseudo-Epic speaks as among the finest horsemen…Saindhava alone means a horse, as well as a man of Sindh. Nearly as famous appears to be the steed of Balhi. (ba_lhika, ba_lhija_ta, i.221.51; v.86.6; R. i.6.24)…

"The reins and goad (the latter, of three pieces) have been already spoken of…Besides the straps of the harness, the horses sometimes wore leather robes and a net, probably as armour. So also a wooden breastplate seems to have been worn. Such is perhaps the uracs'chada (vii.23.36). The bridle-bit (valga_ for ras'mi – vii.27.23; ratha_c caturyujo hemakhali_nama_linah, i.198.15)…

"Mules are used in war…Black-haired mules in a white chariot make a princely gift. (dadya_m s'vetam as'vatari_ratham yuktam anjanakes'I_bhih, as'vatari_bhir yuvati_bhir va_, viii.38.5 ff.) The ass, gardabha, is yoked to a ratha, but here a peaceful wagon is meant; the ass is goaded on the nose as the man walkes beside it (xiii.27.10). Generally when a long journey is to be performed with great speed, mules or asses are taken. In one case a wagon, ya_na, is dragged by mules going fourteen yojanas a day; and some black-necked huge-bodied asses' fly a hundred (yojanas in a day), a feat performed by Nala's horse also. Asses fattened like camels (also used for draught, xv.23.1 ff.) on various nuts, and brought as tribute with camels and horses, are mentioned (ra_sabhayuktena syandanena_ 'suga_mina_ tvaritam gatva_ -- i.144.18-19)…

"rathayuddha (vii.103.23 ff.). 'Then much enraged, and licking his lips, he looked, but found no spot on the foe's body not protected by armour. Nevertheless he shot; with sharp, well-delivered, deathlike arrows he rendered lifeless the steeds, and slew both the side-drivers; he cut the foe' bow and his qui9ver; he cut off his hand-guard (hasta_va_pa). Then the ambidextrous knight proceeded to destroy the chariot, splintering it with arrows. Next the foe, deprived of his war-car, with two sharp arrows he pierced; pierced by arrows was he through both hand-guards in the flesh beneath the nails. Then the kingly foe was tormented and flight became his chief desire; but unto him in that extreme of need flocked his best bowmen, anxious to rescue (their

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king) overwhelmed by the darts of their foe. And the conquering foe they hemmed in with thousands of chariots, with harnessed elephants and horses, with floods of thick-packed footmen; so that neither the knight nor his charioteer nor the chariot was to be seen, for the rain of the arrows and the billows of the people. But the great knight by the power of his arrows broke that protecting array (varu_thini_), and wounded the elephants, now crowding about him. Smitten were the elephants, and smiting they rushed upon his chariot; but firm in all that tumult stood the car.'

"Cavalry. I find in the Epic no word corresponding to this heading, but several for 'horse-riders' (as'va_roha, haya_roha, haya_rohavara, va_jin, sa_din), all meaning 'those mounted on a horse'…Zimmer says that horse-riding is known to the Vedic age, but finds no mounted cavalry in battle. In the Epic age we have, indeed cavalry, but unorganized. (Pa_n.ini gives us a_s'va, but this is not necessarily cavalry). The mounted soldiers are recognized as a body (kulam) apart from others, of course, but do not act together…The arms of the cavalry – men are usually darts only, but we find also spears and knives or short swords used by them. (vii.165.21, sa_Dinah sa_dibhih sa_rdham pra_sas'aktyr.s.tipa_n.ayah sama_gacchan. Compare arms of elephant and horse-riders as pra_sa, mudgara, nistrim.s'a, paras'vadha, gada_, R. vi.52.11)…The riders wore breas-plates and turbans besides their arms. (In viii.(21.23)24.66 (horsemen armed with darts, swords, spears, and wearing kan~cuka and us.n.i_s.a); the khali_na, coverings, etc. of vi.54.59 ff., might belong to any horses)…

"Elephant-riders. The common names for the elephant used in the Epic, gaja, na_ga, dvipa, hastin, Karen.u, Karin, dantin, dvirada, ma_tan:ga, kun~jara, va_ran.a, pota…armed with spikes and iron harness. The tottra, prod, and an:kus'a, hook, are used to urge and direct the beast. To these we have perhaps kan:kat.a to add, as a goad. (vii.187.47 may mean breast-plate or goad)…

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[Ankus’a. Elephant-goad. Top. An:kus’a covered with diamonds; part of the decoration on the handle is enamel. South Kensington Museum. After Fig. 14. Bottom: 1. Tanjore XVII. Steel head and wooden handle; 2. Java XVIII. Head only, all steel; 3. Ceylon XVII. Steel head inlaid with brass and silver, wood shaft; 4. Ceylon, head only; steel inlaid with silver; 5. Central India. Carved steel head and shaft with a brass monster on the end; 6. Southern India XVII. Steel head, ivory handle, shaft carved and fluted cylinders of crystal separated by gilt rings; 7. Rajput XVIII. Blackened steel inlaid with gold; 8. Ceylon, head only, all steel; 9. Silver plated head and ivory handle; 10. Southern India. Carved steel head and wooden handle, separated by an ivory ornament; 11. Ceylon XVIII. Steel head, handle painted with

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bands of bright coloured lac; 12. India. Steel head, flat shaft and butt forged in one piece; wood covers riveted to the shaft; 13. All steel inlaid with silver; 14. Mysore. Very rough iron forging; 15. Very small, probably made for some mahout's child. Steel socketed with a ring on the back, short wooden handle painted red; the points have been rebated so that it could not injure the elephant. 10 in. long; 16. Central India, XVIII. Steel head, carved ivory handle. [After Fig. 15 in: George Cameron Stone, 1934, *A glossary of the construction, decoration and use of arms and armour in all countries and in all times*, New York, Jack Brussel].

Ankus'a, elephant-goad.1.Leaf-shaped central balde, the curved blade is **shaped like a crocodile**. South India, late 17th cent. CE. 2. Metal an:kus'a; the handle is chiseled all over. North India, late 17th cent. Ce. [After Pl. lxxxii and lxxxiii, GN Pant, 1997].

Ankus'a or elephant goad was a boat-hook in general shape with a short spear and on one side of the head a hooked point. [After Fig. 181 in: Frederick *Wilkinson, Edged Weapons*, New York, Doubleday and Company, Inc.] The ankus'a was the main means used by the mahout or elephant-rider to controlt he animal. These are 19th cent. CE examples. The lower one has a hollow haft enclosing bells which roll and jingle when it is raised. The ankus'a lying on top is decorated with gold koftgari work, rubies and diamonds. The upper part is in the form of an elephant's head with eyes of onyx. (Wallace Collection).). [After Fig. In: Stephen Bull, 1991, *An historical guide to Arms and Armor* (ed. By Tony North), New York, Facts on File, p. 174].

Weapons

"The arms inevitably first are bow, quiver, and arrow, as one group. [Bow, arrow and breast-plate are the weapons and defense of the early period. Compare Ait. Br. 7.19 (Weber, *Ind. Stud.* X.30), athai'ta_ni ks.atrasya_ 'yudha_ni yad as'rarathah kavaca is.udhanva).

"Bow.…in the Veda, a_yudha is both the general world for weapon and, without limitation, for the bow. (sarva_yudha, vii.175.12; the bow, vi.118.43). More specific names for this weapon are the commonly used words dhanus, ca_pa, s'ara_sana, and (from their material) ka_rmuka, s'a_rn:ga (viii.79.23)… The length of the bow is several times spoken of as ta_la-ma_tra, a 'palm' long, which, when compared with the numerical qualification employed in s.ad.aratni, may probably be interpreted as six cubits in length. But we hear of the bow of a demon being a cubit broad and twelve cubits long…As in the Vedic age, the knight held the bow as high as possible: that is, with the shaft level to the eye, and well forward, pulling the arrow back to his ear…

"Quiver. Is.udhi, 'arrow-holder'…tu_n.a or tu_n.i_ra; nis.an:ga 'hanger,' may be both sword and quiver. Upa_san:ga also means a quiver…kala_pa is the quiver with its arrows, one word comprising both, and often antithetical to the bow (kala_pa_ni dhanu_m.s.i ca)…

"Arrows…of two chief sorts, vain.ava, 'made of reeds,' and a_yasa, 'made of iron.'..The oldest and commonest names are is.u and s'ara (reed). Like the first in meaning is astra, 'missile,' united with it in is.vastra, the bow, and in the expression kr.ta_stra, which, like dhanurdhara, denotes a fine archer, and is an honorary title of a good knight. Like the second in meaning, but of later use, is ba_n.a, a reed, but employed also of iron arrows; while the very common s'alya means the arrow-point, and thence, the arrow as a whole.[Astra and

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is.u are each etymologically merely a missile telum. Sa_yaka, arrow or dart, conveys the same idea…Late also is ka_n.d.a, 'joint,' in the sense of arrow [savis.am ka_n.d.am a_da_ya mr.gaya_ma_sa vai mr.gam xiii.5.3…the root of astra gives us further pra_sa, 'a projectile,' also a common synonym of any arrow. Compounds of these words are is.uka_ra, is.va_sa and upa_stra, all rare words, the arrow-maker, the arrow-thrower, the little arrow (?)]…ks.urapra is a knife-shaped arrow; that is, with a blade-head…We have in Dron.a's leadership a list of arrows comprising na_raca, vatsadanta, bhalla, an~jalika, ks.urapra, ardhacandra…(In vii.25.57-58 the sa_yaka is a general term for anything thrown (may be sword or arrow)…vipa_t.ha…arrows…

"Club. This weapon appears to be more used than the sword…Like the bow, the favourite club bears a pet name, as in the case of Kr.s.n.a's kaumodaki_. (kaumodaki_ na_mna_ gada_, i.225.28 the vajrana_bhas' cakrah in 22)…The club is called by severalnames, most commonly musala ('pestle') and gada_…The pina_ka also seems to be a general term for the club, but is usually confined to the weapon of the deity, and may mean a bow, as it is later identified with the trident-spit, s'u_la…But beside these we often find parigha, explained by modern works as a catapult, built in the Epic an iron-bound club flung with the hand…The descriptions of this weapon are generally quite uniform, and amount to a heavy inlaid gold-plated sharp-cornered club of iron girded with spikes…To prepare for a club-fight, one binds up the hair, and fastens on a breastplate and helmet (ix.32.60 ff.)…

"Sword. The Epic age seems to represent the epoch where the bow is yielding to the sword. The latter is known earlier; it is used, but not so much, like the club, as a secondary weapon…Indra presents Arjuna with the bow Ga_n.d.i_va; S'iva presents him with the sword Pa_s'upata… (sword) cast like a javelin…As an illustration of this use, compare the verse: 'he was then overwhelmed by (a number of weapons cast at him, namely), sharp arrows, clubs, pestle-clubs, spears, post-clubs, darts, and swords, all spotless and sharp' (iii.204.24). We may translate khad.ga here as scimeter, and add asi and nistrim.s'a as other common names of swords…The asi may be a sabre (often called maha_si, di_rgha_si, 'long sword') and nistrim.s'a a short sword…The sword-belt (mekhala_) sustained the sheath (kos'a), wherein the sword hung on the left side…The Epic writers represent the sword and other offensive iron weapons as being a special product of the western countries. (ii.51.28, the tributaries give apara_ntasamudbhu_ta_n di_rgha_si_n r.s.t.is'aktiparas'vadha_n, 'long-swords and speards and battle-axes made in the west')… nistrim.s'a is synonymous with asi (sword, viii.13.29-30)…[ku_t.akhad.ga (dagger) is pecular to R. vi.80.4]…

"The sword appears to have been worn at all times, as a fully equipped knight is described as 'bearing a breastplate and arrows, and a sword and a bow.' (vii.111.51: compare R.ii.49.5, tatah kala_pau sam.nahya khad.gau baddhva_ ca dhanvinau jagmatuh)…In the Ra_ma_yan.a (vi.51.18), we have a war-car described wherein were thirty-two quivers, many bows and clubs, and two swords, one on each side, with hilts four hands long, themselves ten hands… [Bhi_s.ma, being asked what the best weapon is for all kinds of fighting (kim svit prakaran.au s'res.t.ham sarvayuddhes.u), replies that the sword (asi) is agryah praharn.a_na_m; the bow is a_dyam. He further makes the sword, asi, the type of justice; the Pleiades are its constellation; Agni is its divinity, etc.]

"Spear. This weapon in its various subdivisions is one of the most important in Hindu warfare…The s'akti was a spear or javelin particularly used as an adjunct to the bow by the warrior in the chariot. Hence it often receives the name of 'chariot-spear.' (Although the Petersburg Lexicon correctly explains the rathas'akti as a 'banner-staff',… the general use is that of a weapon). This weapon is made of iron (a_yasi_ s'aktih, vi.104.30; sarvapa_ras'avi_, 116.52), and is represented as cast after the club-casting had failed (hemapat.t.a_ gada_, the golden-plated club, is flung first; then the s'akti, ibid.)…(sharp and flung weapons): pat.t.is'a and r.s.t.i, the kunta, the kan.apa and kun.apa. " (Hopkins).

The pat.t.is'a may also be an axe…r.s.t.i seems to belong more to the common soldiers, and is perhaps a javelin…kunta has the special addition

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of iron and may be a pike used for thrusting…kan.apa…kun.apa…iron projectile (kan.apa, kun.apa are spoken of in i.227.141; vi.57.24; 76.4 ff…they are all on occasion ks.epan.i_ya or missile weapons (vi.76.6). Gos'i_rs.a, in vii.178.23, is probably a spear…In Ni_tipraka_s'a, the ring and cow-horn spear are emblematic of a king)…

"Other offensive weapons…bhindipa_la…missile flung by hand, and is usually associated with darts, hammers, clubs, etc (v.19.3; vi.96.57 ff.; 106.22 ff.; vii.25.59)…tomara is a dart of iron, either straight, or, less often, a straight shaft bearing at the end a hook…Less important missiles are the hammer, axe, spit, and other less definite weapons…hammer, mudgara, if of iron (ayoghana)…the axe, paras'vadha, kulis'a…battle-axe (kut.ha_ra) is Paras'u-Ra_ma's pet weapon. A distinction (unknown) is made between paras'u and paras'vadha (v.19.3; vi.96.57 (ayaskuntaih paras'vadhaih: 46.13:vii.25.59; Ra_ma's axe, xii.49.33; a distinction in paras'u, iii.160.58 (paras'vadha, flung); and in kulis'a, iii.20.34, from paras'vadha, 33. Here N. gives vajra_n.i, thunderbolts, as the meaning of kulis'a_ni. Paras'u is properly nothing but a woodman's axe. Compare R.ii.111.10, drumo yatha_ vane paras'una_ kr.ttah. So da_tra, v.155.7, is merely a sickle.) S'iva's weapon, the trident, is imitated among arms by the s'u_la or spit, a missile of iron, but very effective, and easily cut in tow. The s'u_las'akti is a trident-headed spear. (The last quotation from iii.20.33 ff. mentions gada_, hala, pra_sa, s'u_las'akti, s'akti, paras'vadha, kulis'a, pa_s'a, r.s.t.i, kan.apa, s'ara, pat.t.is'a, bhus'un.d.i_ in a heap. For use stated above, compare vi.92.27; ix.21.24; tris'u_la, trident of S'iva, vii.202.42. Vis.n.u has the cakra and s'a_rn:ga, S'iva the s'u_la or pina_ka)…

"Among projectiles we must reckon the claw-knife or concealed knife (**nakhara**, va_s'i_), besides the simple knife (ks.ura), used as projectile, or as a kind of hand-weapon with which to tear out the eyes of a foe…masses of weap;ons of all base sorts…carried by the infantry (xv.we.r), and by bands of men on elephants. (A list is given in v.155. 'Hair-catchers,' balls of hot iron, sand, oil, pots of poisonous stuff ('snakes'), cords, nooses, concealed knives, etc. Ka_n.d.adan.d.aka may be a regular weapon (trident). Ploughshares (si_ra) are found here, and baskets with pans of coals. The noose, pa_s'a or rajju (cord), is used to throttle the foe. Some such noose seems to be used by the knights as a lasso in viii.53.24 ff., called a pa_dabandha, or na_gam astram, 'snake-weapon'. Comapare this with R. v.46.15, astrapa_s'air na s'akyo 'ham baddhum atya_yatair api).

"Not to be flung, but to be held before one, and to pierce and bore the fo's body, are the s'ala_ka and s'an:ku, said by the commentator to be identical. They are apparently sharp pointed stakes, perhaps of wood (vii.25.50; vi.46.34)…

"A typical sea of weapons is casually presented in the following passage (vii.178.23 ff.): 'they rained upon each other with a stream of weapons – iron clubs, spits, swords, knives, darts, arrows, wheels, axes, iron balls, staves, cow-horns, mortars,' etc. with a last resort to trees torn up, (compare R. vi.55.28; also ib. 61.20)…In this passage, under 'clubs,' we have four kinds mentioned, (gada_, parigha, pina_ka, musala); lances and darts are trebly named (pra_sa, tomara, kampana); arrows are of three names (bhalla, s'ara, na_ra_ca); and there remains the cow-horn and bhindipa_la…and the mortar (ulu_khala); with iron balls that are probably slung or dropped heated on the foe…

"Here we read how the great mass of soldiers drew out in array, and what the arms were: of the common soldiers first, and then specially of the knights (v.155.1 ff.). 'Now the king drew out his forces and divided his eleven armies according to their highest work, their medium ability, and their worthlessness. (sa_ra, Madhya, phalga). Then they advanced, armed and provided with the chariot-planks,' (anukars.a) with large quivers (tun.i_ra), with the 'leather protectors of the war-car,' (varu_tha) with javelins (tomara), and 'quivers for horse and elephant (upa_san:ga), with the foot-soldiers' quivers (nis.an:ga), with metal spears (s'akti), with heavier wooden-handled spears (r.s.t.i), with flags and banners (dhvaja, pata_ka_), with heavy arrows (s'ara_sanatomara, 'avery heavy arrow discharged by a bow' (not a hand-tomara, javelin), with cords and nooses (rajju, pa_s'a), with blankets, with hair-seizers (paricchada and kacagraha…perhaps

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paristara should be read and karagraha; in either case the first word is equivalent to a_staran.a, blankets or coverings of some sort; and the second word, if not hair-catcher, is hand-catcher (kaca- is the usual word: weapon cast upon one…a_stara is boomerang); with lighted (?) powder of pitch (sarjarasapa_m.savah), with bell-hung spears or swords (ghan.t.aphalaka, on sword of spear or even shield, perhaps, phalaka is board or blade), with 'water heated by iron balls,' (ayogud.ajalopala) and stones, with spits and spears (s'a_la- or s'u_la-bhindipa_la), with 'missiles of wax melted,' and hammers (madhu_cchis.s.t.a-mudgara), with trident or spiked staves) (ka_n.d.adan.d.a = kan.t.akadan.d.a, or v.1. dan.d.akan.t.aka, same meaning), with ploughshares and darts (javelins) that are poisoned (si_ravis.t.atomara), with 'baskets with which to fling hot balls, and the box containing these balls resting in the baskets' (s'u_rpapit.aka), with hooked-lances (an:kus'atomara (or javelins), with wooden breast-plates (ki_lakavaca or ki_lakrakaca, saws in wooden handles), with weapons concealed in wood (va_s'i_ or va_si_), with 'blocks of wood with iron spikes' (vr.ks.a_dana), with tiger and leopard skins 'for man and war-car', with dart and horn (r.s.t.i and s'r.n:ga: 'r.s.t.i is a hand-missile used among the Dravidians, crooked, with wooden shaft (phalapa)': s'r.n:ga is curiously defined by N. as 'a means of freeing (killing) on ebleeding when smitten with a club; (?) hud.a or hula, in the list of iii.15.5, defined by a commentator to Manu, reading hud.a for gud.a in M. iii.133, as a double-edged sword; but the Epic commentator in iii.284.4 defines it as a privy-horn, mu_tra_dyutsarjana_rtham s'r.n:gam), with crooked javelins, with axes, spades and oil of sesame and flax [pra_sa (bhalla), kut.ha_ra, kudda_la, tailaks.aumasarpis: the last explained as protective oil-cloth], and gilded nets(rukmaja_la).' Such was the array of the Kurus, exclusind the chariot-description following, where we also find javelins, bows, etc.

"These weapons are all retained or discharged by the hand…

"The barbarians are worse than the natives as to their arms, but are occasionally spoken of in an angry way as using un-Aryan methods. What could be more Aryan, however, than the arms poured out upon Arjuna by the barbarians in general (mlecchas)? 'They cast upon him the eared reed arrows, and iron arrows, the javelins, darts, spears, clubs, and bhindipa_las' that the Aryans themselves used. [karn.ina_li_kana_ra_cais tomarapra_sas'aktibhih, musalair bhindipa_lais'ca, viii.81.12 ff.] But we learn that the Kira_tas use poison (and appear to be blamed for it!); that the Ka_mbojas are particularly 'hard to fight with'; that the barbarians generally are 'evil-minded'; that the S'akas are 'strong as Indra' (vii.112.38 ff.); that the barbarians generally use 'various weapons'; that the Ka_mbojas, agai, are 'cruel and bald'; that the Yavanas carry especially arrows and darts; and that the mountaineers, Parvati_yas, are proficient in throwing stones, an art the Kurus asserted to be unfamiliar with (vii.119.14 ff.; 121.14; as'mayuddha, s'ila_yuddha, ib. 31-45.36,32).

"…several foreing excellencies in war-like matters (are grouped) under one head…each nation shall use its own arms. 'Let each man fight according to his native usage. The Ga_ndha_ra_h and Sindhu-sauvi_ra_h use claw-knives and darts (quoits?) (nakharapra_sayodhinah); the Us'i_nara_h are good at all weapons; the Pra_cya_h are excellent at elephant-fighting (ma_tan:gayuddha); they are also deceitful fighters (ku_t.ayodhinah); the Yanava_h and Ka_mboja_h, with those living near Mathura_, are expert in kicking (or boxing? Niyuddhakus'ala_h); the Da_ks.ina_tya_h are especially swordsmen (asipa_n.ayah)' (xii.101.1 ff.)…

Armour and Defence

"The armour described belongs to the knight…skins were used as shields to the chariots, even rhinoceros-hide (kha_d.gakavaca) being so employed…We have a picture of a Hindu warrior, as he stands ready for battle. He is 'armed with a cuirass, and with guards for his hands, and has on his fingers the protector, on his arms the guard against the bow-string.' (iii.37.19; x.7.52, kavacai_ satalatra_n.o baddhagodha_n:gulitrava_n, and dhanus.pa_n.ir baddhagodha_n:gulitrava_n)…of what material

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the pieces of defense, mainly shields, cuirasses, and breasplates, were made. We find them seven in kind: iron, copper, brass, silver, gold, wood, hide...

“Varman and kavaca are the usual names of the body-armour. [s’ara_vara(n.a), ‘arrow-guard’, may be anything that protects the body from arrows, as shields, helm, breastplate, or quiver. As shields, perhaps, in vi.60.17; vii.14.72]… Varman, generally iron, and carman, leather armour, are often mentioned together (vii.148.40; i.194.7)…Next to the varman and kavaca comes the shield, called carman, which is of leather adorned with figures (vi.54.26 ff.); or a simple tiger-skin or bear-skin worn over the body besides the brazen breastplate served as a shield…The shield (that is, hear a real shield, worn as a plate) might have as many as three bosses (carma triku_t.am, xii.166.51 ff. As carma_n.i are differentiatd from phalaka_ni xii.100.9, I prefer to take phalaka here and in x.8.59 as ‘sword’.)…

“The helmet (s’irastra_n.a, ‘head protector,’ with the kiri_t.a, as part for whole) is represented to be of metal and adorned with gems, chiefly the diamond…It is worn over the ear-rings (R.vi.78.16). The little towers called nirvyu_has figure apparently as helmets andmust have been high head-pieces, perhaps a kind of tiara…The commentator defines the word as a weapon. There was a band of cloth, turban, called us.n.i_s.a or ves.t.ana, which was worn with the helmet. (s’irastra_n.a is of gold, iv.55.57; ix.32,63 (ja_mbu_nadaparis.kr.tam); viii.21.27 (susam.naddha_h kavacinah sas’irastra_n.abhu_s.an.a_h); xi.18.18 (s’irastra_n.a_ni). Nirvyu_ha with the sword (sanirvyu_ha_h sanistrim.s’a_h), vii.89.17; v.19.4. Us.n.i_s.a with the helmet (sos.ni_s.am sas’irastra_n.am.. (s’iras) apa_tayat), vii.54.28)…The head with helm and earrings ‘looks like a full moon’…Brazen, ka_m.sya, implies brass used quite as much for adornment as for use; and it is quite possible, therefore, that mention of brazen arms must be classed in the same category as that of golden. (‘brass and gold’ are as noble petals put parallel, as ka_m.syam ca haimam ca sarvam, viii.2.29)…

“The ultimate expansion of the theory of weapons resulted in the theory of war, and this was expanded agin into a theory of polity; and we thus have on one side our modern ni_tis’a_stra or ‘system of royal polity,’ and on the other the practical instruction in the use of arms or the ‘science of weapons.’ Thus, in a late book we read: ‘he will comprehend the science of weapons, and the different weapons, and the system of polity.’ (xiv.66.24. In the later books, the ‘system of polity’ was so familiar as to be used in proverbs: e.g. adhi_tya ni_tis’a_stra_n.i ni_tiyukto na dr.s’yate, ‘not everyone that has perused the works of polity is wise in polity’: xiii.164.7. The Agni Pura_n.a gives a dhanurveda (in chapter 248 ff.) The account describes the names, lengths, and methods of using various arms, with the proper employment of forces). A system of war is implied when we read, for example, of the ‘system of Us’anas,’ ‘the system of Angiras’ son,’ etc. [The general furniture of cars, men, horses, elephants, etc., goes under the name of bha_n.d.a.]…

“The kettle-drum, dundubhi, is often mentioned as accompanied by the bheri_…In the Ra_ma_yan.a it (bheri_) is beaten with a stick…The many kinds of drums and like instruments are shown by groups frequently found, such as this: ‘they then brought forth the very loud sound of the pan.ava, mr.dan:ga, dundubhi, krakaca, maha_naka, bheri_, and jharjhara’ (vii.39.31). To these we may add pes’I_, also a drum, and pus.kara, as indefinite, defined the same. (vi.47.7-8; 99.17-18)…Quite common also is the muraja, tambourine, but the drum pat.aha is very rare…The usual instrument for trumpeting was the conch-shell, bearing etymologically the same name, s’an:kha, and carried by each chief. Compare this description: ‘then standing on the great car drawn by white horses, he blew in his gold-adorned shell – Arjuna blew in his shell Devadatta; Kr.s.n.a, the shell that was called Pa_n~cajanya…’ (vi.51.24. The shells of the other Pa_n.d.us have also their names given in the same verse. Bhima’s is named Pa_un.d.ra; Yudhis.t.hira’s Anantavijaya; the twins’, Sughos.a and Manipus.paka.)…A number of new instruments, t.an:ku, d.amaru (with khet.aka), d.amaruka_, etc., meets us in the Puranic period. (Compare Ag. P. 43.27; 50.2,8; 52.24,31 ff.,

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etc.)…We find, not one, but a band (gan.a) of musicians singing the deeds of old heroes, and accompanying themselves on the lyre (vi_n.a_), and called vi_n.a_ga_thin (lyre-singer). (S'at. Br. Xiii.4.3.3 and 5; WeberI.8.i.187)…'Sing ye the king or some other braver hero' is the command given to the two lute-players in the course of the ritual (Pa_r. G.S. i.15.7)…the congregational singing (va_n.asya saptadha_tur ij janah: RV x.32.4) shows us that a lyrical beginning is probable, and that not of a late, but of an early period…For sacrifices as important as a horse-sacrifice, the divinities kindly provide the music; Tumburu and other celestials 'expert in song' (as well as in dancing) officiate as chief musicians at the most celebrated of these ceremonies (xiv.88.39), and seem to be a survival of the musical exhibition as wont to be performed by men…(women singers) appear to belong properly to processional music, and sing to the sound of various instruments as the victor goes by, being accompanied by the su_tas, ma_gadhas, and na_ndi_va_dyas (iv.68.28)…(ga_tha_ is a secular song, distinct from sa_man, a religious song)…The lyre (vi_n.a)…described as having seven cords, saptatantri_ (iii.134.14). The seven musical scales are described as a branch of study (va_n.i_ saptavidha_, ii.11.34); and we have the bass described as the chord giving the 'big sound', maha_svana…The common reed-flute, known as ven.u, and found everywhere in the Epic beside the lyre, is not known to the Rigveda by that name; but other reed instruments (na_la_, na_d.i_, etc.) are common from the earliest time…"
[Edward W. Hopkins, 1889, *The social and military position of the ruling caste in ancient India as represented by the Sanskrit epic*, repr. 1972, Varanasi, Bharat-Bharati]

The Dhanurveda is clear about who was eligible to learn the science. (Verse 3: dhanurvedaguruvipra prokto varn.advayasya ca yuddha_dhika_rah s'u_drasya svayam vya_pa_dis'iks.aya_: every god and soldier, every bra_hman.a and ks.atriya and every youth, physically and mentally fit and not belonging to the lower caste, was expected to learn the science. The s'udra could learn it of their own for hunting purposes; cf. Agni Pura_n.a 100.7). Kaus'i_taki_ Bra_hman.a notes that the best daks.in.a_ for a guru was a bow and three arrows.

A consequence of urbanization is the beginning of organized irrigation and organized warfare.

Storing of agricultural surplus is perhaps evidenced by the so-called warehouses found at Harappa. The rise of the cities on the banks of the rivers also necessitated the re-training of rivers using 'gabar bunds' to direct the flooding waters from meandering river channels into irrigation canals and channels for transport. Inaction could otherwise lead to river-floods damaging the crops and settlements fortified by mud-brick walls.

Sapara. "An ancient type of Assyrian sword. It has a very peculiarly curved blade and no guard. (Burton Sword 207)." [GC Stone, Fig. 694, p. 539]. **Note the incised figure of an antelope seated on a pedestal.**

<u>Image: spotted deer</u>: **pha_r.ho** hogdeer or <u>cervus porcinus</u> (S.); **pa_hr.a_** (L.P.); **pa_r.ha_** spotted antelope, hogdeer (H.)(CDIAL 8044). 6596.**<u>Wild goat</u>**: **pa_r.o** wild goat, fawn (Ku.); **pa_d.asa** fawn (OM.)(CDIAL 8042). **benkre** a wild goat (Kon.lex.) cf. **bakri_** goat (H.lex.)

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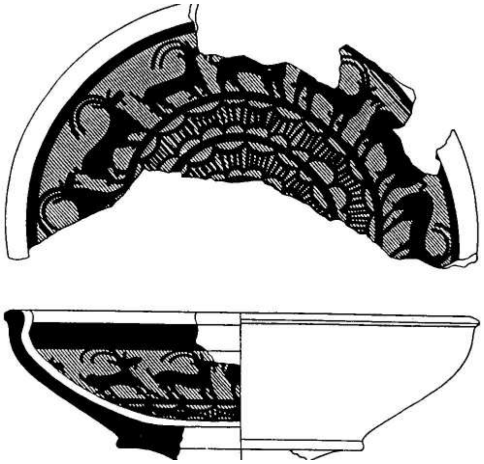

s'uru the wild goat or markhor (Kt.); **s'a_ru** ibex (Pas'.)(CDIAL 12331). **s'ambara, s'abara, sambara** a sort of deer (Ka.); **sa_mbara** (M.) (Ka.lex.)

Nausharo. Decorated pedestalled bowl. Period IV (c. 2100-2000 BCE). [After Fig. 2, JF Jarrige, From Nausharo to Pirak: continuity and change in the Kachi/Bolan Region from the 3rd to the 2nd millennium in: *South Asian Archaeology 1995*].

“Contemporaneous with the decline of the Indus Civilization, the Pirak Culture with its characteristic geometric polychrome pottery arose on the Kachi plain where the site of Mehrgarh had also prospered. Here horses and camels were domesticated for the first time in South Asia, and the riding of horses is clearly attested. Another major transition occurred as summer crops, namely sorghum and rice, were added to the existing winter crop assemblage which was dominated by wheat. This saw-toothed stone sickle was probably used to harvest these cereals.”

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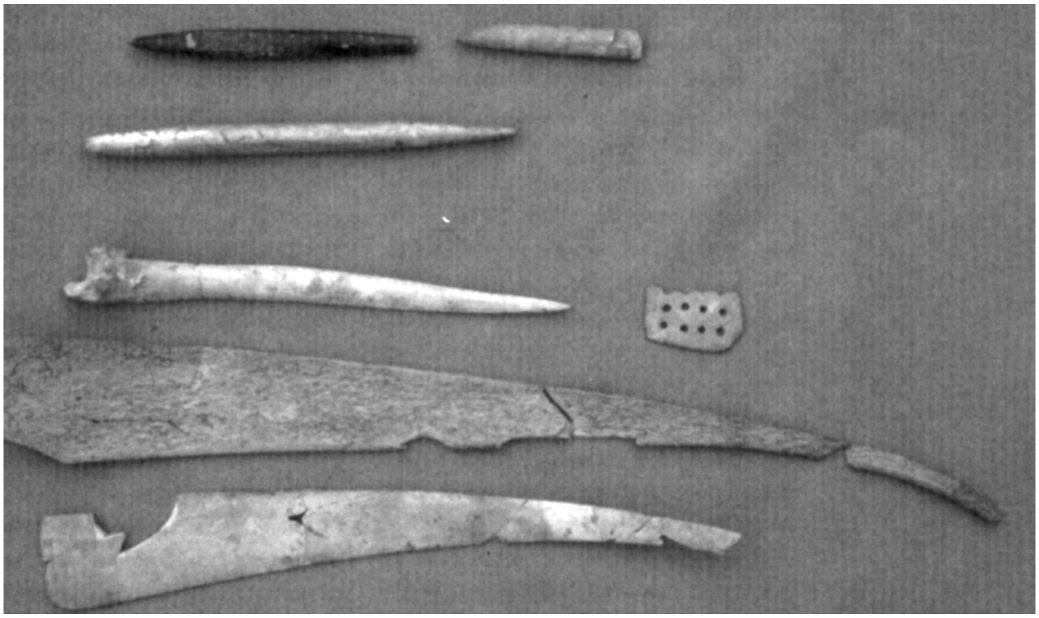

Bone tools – projectiles, weaving instruments -- circa 3300 to 2800 BCE. Harappa. (After Harappa Archaeological Research Project/Courtesy Dept. of Archaeology and Museums, Govt. of Pakistan).

Vedic Chariot

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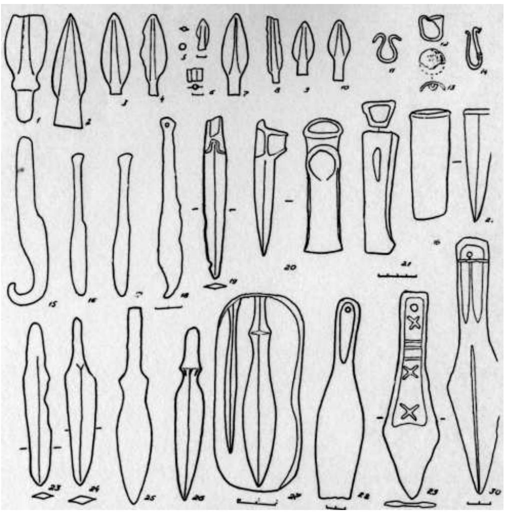
“The earliest chariot was a car of two or three wheels, and with one, two, or three horses; in the Epic we find the same, or one of four, sometimes eight, wheels; and with two, three, or four horses, or (in the latest portions) eight.

“In particulars, we find the Vedic war-car, ratha, placed on a box, kos’a, fixed on a wooden axle, aks.a, fastened by cowhide thongs. The seat, bandhura, is single; in the case of gods, three to eight seats, as fancy dictates, are mentioned. The knight stands on the floor of the car, garta, to the left of his driver. A rim is perhaps to be assumed as protecting the car, called an:ka… The wheel-spokes are of wood. A banner-pole stands erect in the car. (Pa_r. G.S. iii.14.13 stambha). A horse stands on each side of the pole, and the two are yoked, guided by a bit, s’ipra_ and reins, while urged by a goad (or whip)…The car and pole were decorated. Axe and bow were the chief weapons, but knives and others smaller are used…” [Edward W. Hopkins, 1889, *The social and military position of the ruling caste in ancient India as represented by the Sanskrit epic*, repr. 1972, Varanasi, Bharat-Bharati]

Weapons. Andronovo type. Namasga settlement; 2. Ashgabar; 3. Bala-Ishem site; 4. Anau settlement; 5. Shortugai settlement (period IIB); 6,23,24,29. Tulhar cemetery; 7. Uzbekistan; 8. Kuin-Kuju well; 9. Togolok 5 settlement; 0. Tahirbai 2 settlement; 4 Kumsai cemetery; 2. Tandyrjul cemetery; 3. Jazdepe settlement; 5,27. Kangurt-Tut settlement;
6. Beshkent II cemetery; 7. Arsaf-Sai; 8. Nurek cemetery; 9. Tiger Gully cemetery; 20. Karim-Berdy settlement; 2



. Kultintepe; 22. Varahsha; 25. Kala Koderay site (period IV); 26. Tashkent oasis; 28. Vahshuvar; 30. Dashly 3 settlement. The radiocarbon dates for wood and charcoal samples from Sintashta are from the twenty-third to fourteenth centuries BCE. “…the wargear of a charioteer, i.e. a chariot, a composite bow and arrows, and armour (S’Br. 5.3.5; ABr. 7.9; TBr. 2.03). A bronze knife-dagger, a stone axe, a stone four-edged mace, leather armour and a whip are also mentioned. Gods fight with these weapons and bestow them on heroes. The Avesta describes the same panoply and armour (Yashts 5,7,0,5,30,0,30)….Mitanni…the charioteer was armed with a composite bow, two quivers with 30 socketed arrows, a spear, a dagger, a whip, a leather cap protecting the head, neck and shoulder and cuirass with split sections. It is described in the texts from Nuzi (Zaccagnini,
978).” [E.E. Kuzmina, 997, The cultural connections between the shepherds of the steppes and south Central Asia, Afghanistan and India in the Bronze Age, in: *South Asian Archaeology 995*]. Tus’ratta, the Mitanni king, sent bows as a gift to Amenhotep III and three quivers with 90 arrows to Amenhotep IV.

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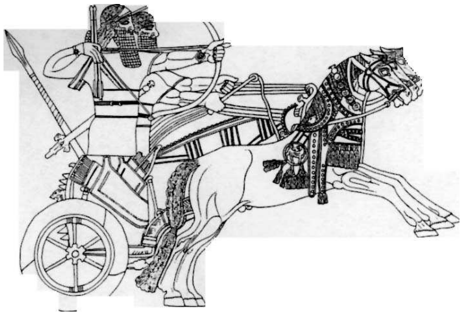
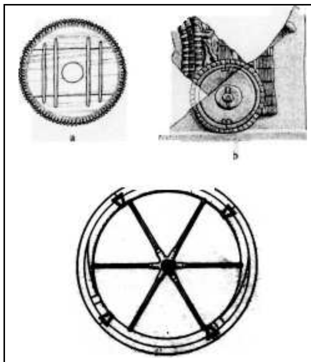
Nimrud. Detail of a stone relief of Ashurnasirpal II (After Littauer and Crouwel, 979, *Wheeled vehicles and ridden animals in the ancient Near East*, Leiden, fig. 53). “Ninth-century BCE Assyrian chariots (figure 53) appear to have had draft poles in Y form…The rear-axled chariot is still shown as a fast, mobile firing platform for flanking, pursuing, and harnessing. Because only two of the horses were under yoke, the vehicle remained quite maneuverable. **Crossed quivers (containing bows and arrows and sometimes axes) were fixed outside the body, and a thrusting spear stood at the rear; the two last, being short-range weapons, were for use dismounted or from a standing vehicle.”** (JH Crouwel and Mary Aiken Littauer, Chariots, in: Eric M. Meyers, ed., 997, *The Oxford Encyclopaedia of archaeology in the near east*, Oxford University Press, pp. 485-487).





Figs. a,b,c. Wheel types. (a) reconstruction of a wheel type from graves in Kish, Ur, and Susa, mid-third millennium BCE; (b) depiction of a wheel on a stela of Gudea, late third millennium BCE; (c) drawing of a six-spoked wheel surviving from eighteenth-dynasty Egypt (After Littauer and Crouwel, 979). “Archaeological evidence for the wheel appears in the Near East as early as the Early Dynastic II period (c. 2750-2650 BCE). Earlier pictographs from Uruk level IVa (c. 300 BCE) show sledges raised over what are eigher two captive rollers or four disk wheels. Remains of actual wheels were found in graves at Kish, Ur (Early Dynastic III), and Susa (figure a) in the mid-third millennium. These were all tri-partite; made of three planks cut vertically from a tree trunk and held together by external battens as well as by rawhide, with wooden or metal tires (from .5 to .83 m. in dia.) that were sometimes hobnailed…The wheels appear to revolve on fixed axles. A variation of this wheel first appears on a stela of Gudea in the Ur. III period (fig. b), in the late third millennium. It shows what seems to be a relatively small solid wheel rimmed by two metal half tires with hobnail tread, secured by clamps at either ends. Actual metal tires in six or seven segments, with a clamp at either end and one in the middle, indicate disk wheels with diameters of .67--.97 m. These come from early second-millennium Susa, As’s’ur, and elsewhere.

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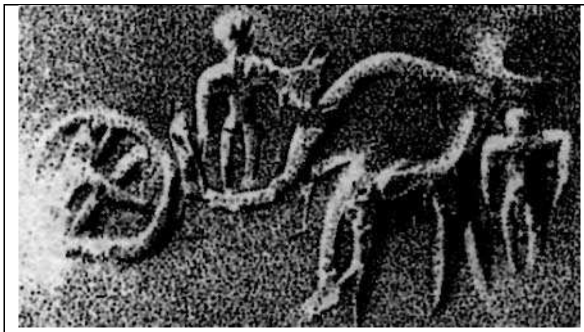
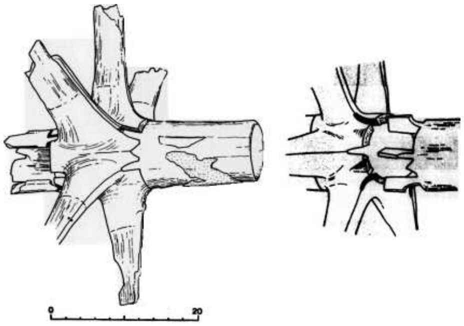


"Of lasting significance were attempts to lighten the disk wheels, as first seen on a third-millennium seal from Hissar IIIB (fig.2). On it, the central plank, through which the axle passes, is narrowed to a diametral bar; the flanking planks of the Hissar. Depiction of a wheel on a seal from Hissar IIIB. 3rd millennium BCE (After Figure 2, Littauer and Crouwel, 979). tripartite wheel are eliminated, and the former bonding slats are turned into sturdy transverse bars between the diametral bar and the felloe. This crossbar wheel is also clearly illustrated in the second millennium BCE, fixed on a revolving axle; it has remained in use with simple carts in various parts of the world.



"By far the most important innovation was the spoked wheel, which first appeared with four to eight spokes, in Anatolian and Syrian glyptics and other graphic remains from the early second millennium BCE. Actual four-and six-spoked wheel (fig. c) survive from eighteenth-dynasty Egypt. These have composite spokes made from single rods, half oval in section, and heart bent in the middle to form an angle (of 60 degrees for a six-spoked wheel and 90 degrees for a four-spoked one). The 'legs' are glued back to back to the 'legs' of the adjacent spoke, the resultant whole spoke being fully oval in section. The wider diameter of the spoke is set at right angles to the felloe, which is composed of two lengths of heat-bent wood, overlapping at the ends. Rawhide, applied wet, constricted and solidified the naves and felloes. This construction, based on tension and without metal parts that could be jolted loose, required great skill to make and was vulnerable to dampness. It is attested in Egypt, the Levant, and the Aegean…

"Third-millennium representations in Mesopotamia show disk-wheeled vehicles in military, hunting, cult, and travel contexts only. Evidence for their use in warfare, for which they were clearly unsuitable, fades rapidly after the middle of the millennium." (JH Crouwel and Mary Aiken Littauer, Wheel, in: Eric M. Meyers, ed., 1997, *The Oxford Encyclopaedia of archaeology in the near east*, Oxford University Press, pp. 343-344).

Egypt. Tomb of Amenophis III. Nave and spokes of wheel. This is a clear depiction of the evolution of the spokes of a wheel from the earlier styles of wheels with bi-partite or tri-partite joined planks constituting the solid wheel.

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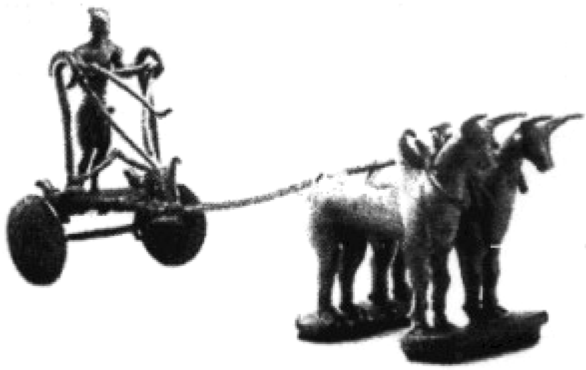
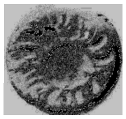
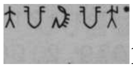
Chariot A I (Obj. no. 22, Cairo Museum, [After Pl. VII in: MA Littauer and JH Crouwel, 985, Chariots and Related equipment from the Tomb of Tutankhamu_n, Oxford, Griffith Institute.]

'The six, actual, full-sized chariots of Tutankhamu_n are of singular importance, not only to the history of chariotry in general, but to the understanding of Late Bronze-Age warfare…Chariots are first attested in Egypt in the earlier part of the 6th cent. BCE, on the so-called 'second stela' of the pharaoh Kamose, where the text refers to the 'chariotry' of his enemies, the Hyksos, and this is followed by a few texts and representations of Egyptian chariots of early New Kingdom date…In Egypt, chariots were included among the grave goods of pharaohs. No harness animals, however, were buried with them, as they had been in Mesopotamia and Elam in the 3rd millennium BCE, and as they were to be in China, from the Shang period onwards, and in st millennium BCE Cyprus

…Chariots A1 and A2 (called 'state chariots' by Carter) are conspicuous for their sumptuous decoration in gold and inlay, which covers virtually all parts, and which would seem to restrict them to parade and ceremonial use…(Amarna letter 22, describing the splendid chariot and equipment given by Tushratta, king of Mitanni)…Egyptian representations of chariot horses show that these were controlled either by a bitted bridle or by what appears to be a cavesson, with noseband placed so low that it could exert pressure on the sensitive, fleshy part of the horse's nose, below the end of the nasal bone. [cf. MA Littauer, *Antiquity*, 43 (1969), pp. 292 f.].

ra~t = a car, a four-wheeled carriage; tat., rat.rat., rat.rut. = to creak, creaking, an imitative word; rat porob = the car festival; rat – the car of Jagannath, the car festival; observe the car festival; rat = a car, a four-wheeled carriage; rath (H.) (Santali.lex.) rath [Skt.] a war-chariot, a car; ratha-ja_tra_, ratha-ya_tra_ a festival observed in Vis.n.ava temples on the 2nd day of the bright fortnight of the month of A_s.a_d.ha (June-July), on which day the idol is placed in a chariot, and driven round the city; rathi_ = a warrior who sits in a chariot and fights; rat.na_ adj. Wandering, roaming; rad.a-vad.a = wandering about (G.lex.) ?ran.a = a battle, a war, a fight, a quarrel; a battle-field (G.lex.)



 m0428Bt  1607 Pict-132: Radiating solar symbol.**ra~t** = rays of the sun, glare (Santali.ex.) ra_t = a sunbeam, ray of the sun, glare. [?Or, **bel.a** day-time]

rata sukri = a boar (Santali.lex.)

rad.h [Hem. Des. lahad.a = Skt. ramyam, charming] deep meditation (G.lex.)

Daimabad. Copper model chariot with solid wheels; a standing charioteer and a curved draught-pole drawn by two bullocks. Daimabad, on Pravara river, a tributary of Godavari, near Nasik; this is a

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settlement dated to ca.1961 to 1420 BCE. Other bronze models found at this site, include animals mounted on four-solid wheel platforms. Daimabad site is generally considered a post-Harappan settlement. The suddenness with which such a bronze-model 'chariot' appears cannot be seen as an isolated occurrence. The 'chariot' is a vehicle which dates back to the Vedic times in Indian civilization with extensive metaphors revolving around the 'ratha' starting with the R.gveda. [Source for the pictures: Sali, S.A. 1986. *Daimabad 1976-79*. New Delhi: Archaeological Survey of India; Fig.10.55 from Allchin, B. and Raymond Allchin, 1982, *The rise of civilization in India and Pakistan*, Cambridge Univ. Press; Fig. 4.5 from Kosambi, D.D., 1965, *The culture and civilisation of ancient India in historical outline*, London, Routledge and Kegan Paul].

Daimabad chariot is an import from Harappa

Kosambi explains the chariot model: ""Dholavira is a purely chalcolithic site which, as the excavations show, was first occupied around 2200 BCE and was finally deserted by 1000 BCE after which it was never reoccupied. Hence the artifacts from the site can be safely placed between circa 2200 BCE - 1000 BCE (uncalibrated)...The bull chariot is the most remarkable piece in the hoard. Its total length is 45 cm and the breadth is 16 cm. The complete bronze consists of an elaborate chariot yoked with two bulls and driven by a man in it. It has two solid wheels having a projecting hub on the inner side in which the axle is fixed in such a way that it moves along with the wheels. It looks more like a Roman biga than a cart and justifies its classificatin as a chariot. It has a front guard consisting of two vertical curved bars with turned upper ends, whereas the lower ends are attached to a horizontal bar which, in its turn, has two ring loops for the axle. The guard also has two horizontal bars fixed to it. Of these, the upper one is straight while the lower one is angular. The guard is furtherstrengthened by two oblique bars soldered together in a dog standing on the central pole just in front of the guard. The platform on which rises the guard has on its either side a pair of birds formed into one by merging bodies, but having their heads in opposite directions. Stylistically they are related to the terracotta bord whistles from Harappan sites. The man (ht. 16 cm) driving the chariot is seen standing on the platform. His left hand rests over the front guard and in the right hand is a curved stick. The man is portrayed realistically. His physiognomy indicates that he is probably a Proto-Austroloid. To a great extent, he resembles, stylistically, the terracotta head of a man from Kalibangan which, according to BB Lal, resembles the head of the famous limestone priest from Mohenjodaro (Lal 1979: 89, pl. XXIV). He has a broad, snubbed nose with wide nostrils; his lower lip is thick and protruding. His curly hari, indicated by incised lines, is parted in the middle and is gathered at the back in an elongaged role. He does not appear to be wearing any lower garment but a vertical projection of the abdomen, looking like a hooded cobra, must been part of the lower garment. The chariot has an inordinately long central pole, 32 cm. long. The bulls are not fixed to the yoking pole and can be removed whenever required. It may be noted that the modern cart in Sind also has an inordinately long pole, but a high bent pole seems to be a peculiarity of Sumerian chariots (Mackay 1929: 28, fig. 1 and 2). The pair of bulls hoked to the chariot are extremely interesting in as much as the modelling of their hind part has lent them the appearance of a horse rather than that of a bull, and their tails look more like a horse's tail. And what is more, their mouth too resembles that of a horse. This bull-horse combination of the body is strikingly similar to that of the unicorn which is so commonly depicted on Indus seals. It is equally noteworthy that a unicorn with two horns has been carved on a seal from Kalibangan (Lal 1979: 91). The most remarkable feature of these bulls is their projecting horns. This is a feature which is characteristic of the terracotta

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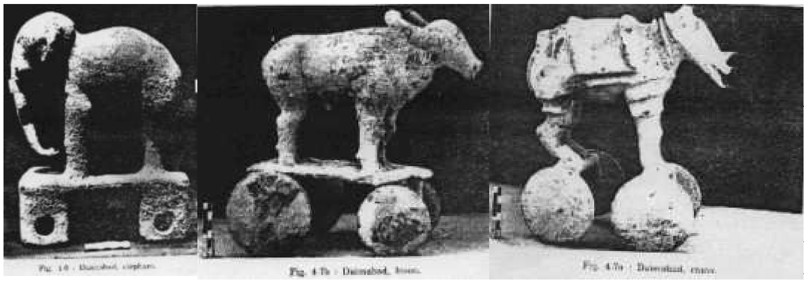
bulls from Chanhu-daro excavations and we are told that they are even today seen in Sind (Mackay 1943: 164, Pl. LVIII, 1 and 1a). Such bulls, however, are not represented in the chalcolithic art of the Deccan.

"It will thus be clear that the chariot is characterised by many Harappan features. It should, however, be made clear that such an elaborate vehicle has so far not been reported from any Harappan site and what we have are only a few toy cart models of copper (Piggott 1970). But they too share some elements in common with the Daimabad chariot. They all have projecting ring loops through whch the axle was passed. The most noteworthy feature of the axle is that it is fixed to the wheels in such a way that it moved along with them. The same feature is also to be noticed in the case of the Daimabad chariot. About the toy carts, presumably of bronze, from Chanhu-daro, Mackay (1943: 164) reports that, 'The wheels are now immovable, but they must originally have revolved in two axle-brackets cast in one with the frame'. This possibly facilitated the dismantling of the vehicle because the chassis could just be lifted off the axle as they do today in Sindh (Mackay 1929: 26-28). It is pertinent to quote Childe in this connection who observed that 'Sumerian and other early vehicles were probably just as easily taken to pieces, and this point must be remembered in considering the possibility of using them for long distance transport' (Childe 1951: 183). This could be possible because of the manner in which the axle was fixed to the wheels. This mechanism, we are told actually marks an early stage in the evolution of wheeled vehicles (Singer et al 1956: 72). And even in the village carts of modern Sind, which 'Preserve the main outline of the ancient Harappan vehicles, the wheels turn in one piece with the axle as do those of many other recent carts with solid wheels.' (Mackay 1929). This can thus be said to be a distinguishing feature of Harappan vehicles and the same is to be seen the Daimabad chariot."(pp. 163-165).



Daimabad, bronze. The model with the elephant is instructive. The holes in the base are for inserting the axles and wheels. This structure of the 'rathava_hana', of stand for the vehicle, is comparable to the Chanhudaro chariot box which has also protruding tongues with holes to insert the wheels and axle. The wheels shown on other animal model stands are solid disc wheels.

"The exact find spot (of the bronze models) was examined by S.R. Rao (1978: 62) who confirmed that the bronzes belonged to the Late Harappan phase (ca. 2000-1800 BC). The calibrated dates would be ca. 2200-2000 BCE which would place it in the Late Mature Harappan phase. The next problem relates to the authorship of the bronzes. DP Agrawal (1978: 45) has questioned their antiquity on the basis of the presence of arsenic which, according to him, is absent in artifacts from chalcolithic sites in the Deccan...It has been observed that 'The hardness of most of the copper objects found at Harappa has been shown on analysis to be due to a high arsenic content. The presence of this arsenic is believed to be accidental, being indigenous to the copper deposits from which the ores were extracted rather than secondarily introduced' (Coghlan 1951: 44-45). Lamberg-Karlovsky (1967: 151) therefore rightly argues that 'We must not disregard the possibility, however, that the

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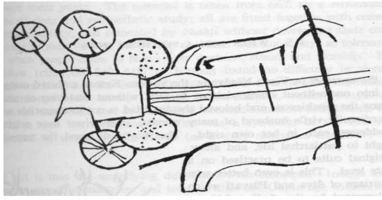
smiths recognised the advantages of an ore with arsenic in it for producing a harder, less brittle tool'. In the light of evidence of Harappan artifacts, we are of the opinion that the Daimabad bronzes may originally have been Harappan, that is, from Harappa proper, and that they were probably imported into the Deccan. Arsenical alloying is also most significant in the Copper Hoards from the Ganga-Yamuna doab (Agrawal et al 1978)..." (p. 168)

Controvery of authorship of Copper Hoards in Ganga-Yamuna doab: Nishadas or Aryans?

"The origin and development of Copper Hoards is the knottiest problem. In an exhaustive study SP Gupta (1963: 1965) has attempted to trace the evolutionary stages of Copper Hoards...It is highly likely that the Copper Hoards originated in Bihar where the ore is also available...it is well night impossible to provide a reasonable time bracket for Copper Hoards...The Ochre Coloured Pottery (OCP) is not found in eastern UP and Bihar which, according to Gupta (1963), was the original home of the Copper Hoard people. We may not be far off the mark if we assign them to the middle of the second millennium BC, say between 1700-1400 BCE... The Copper Hoards problem again received attention of scholars when a hoard was accidentally found while digging a canal at Bahadarabad (Dist. Dehra Dun, UP). Immediately a small excavation was undertaken at the site by YD Sharma (1961), but no copper artifact was found in the pre-Painted Grey ware levels, which were the earliest. Since Lal associated the Painted Grey ware with the Aryans, the OCP clearly belonged to the pre-Aryan period. He concludes (Lal 1951: 38). "Thus, if the copper hoards are to be associated with the ill-fired, ochre-washed, thick ware, it would follow that they are the products of a people who inhabited the Gangetic basin, presumably before the arrival of the Aryans." Lal based his argument on the evidence of the bar celt which forms an important type in

Morhana Pahar, Central India: rock painting of chariots ambushed by men on foot



Copper Hoards. This tool was a copy in metal of the stone prototype which was found in the Chota Nagpur region from where Copper Hoards have also been reported. Moreover, a tool resembling the harpoon in the hoards is found depicted in prehistoric cave paintings in the Mirzapur district of UP which is in the Vindhyan region. These analogies led Lal (Ibid: 39) to conclude: 'If these similarities have any significance, it would appear that the authors of the Copper Hoards were once associated with the areas just stated. At present these tracts are known to be chiefly occupied by Mundas, Santhals and other tribes belonging to the Proto-Australoid group of the Indian population. Can it then be said that the ancestors of these Proto-Austroloid tribes were responsible for the Copper Hoards...The Vedic Aryans, on reaching the plains of northern India, encountered certain aboriginal tribes whom they called the Nishadas.' All said and sone, the Copper Hoard problem is stilla controversial issue in Indian archaeology". (pp. 258-260).

Spoked-wheel chariot of ca. 800 BCE

Two views of the chariot painted on the Morhana Pahar cave. See also notes at: http://sarasvati.simplenet.com/ratha4.htm

[Sources: Fig.8, Discus-throwing charioteer in a Mi_rza_pu_r Cave, circa 800 BCE in: Kosambi, D.D., 1965, *The culture and civilisation of ancient India in historical outline*, London, Routledge and Kegan Paul;

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Fig. 4.12 Morhana Pahar, Central India: rock painting of chariots ambushed by men on foot in: Allchin, B. and Raymond Allchin, 1982, *The rise of civilization in India and Pakistan*, Cambridge Univ. Press].

Kosambi goes on to surmise and present arguments: "The Dark Hero of the Yadus. The creed which would survive to the twentieth century as the 'true religion' for millions in India was not to be Buddhism but the heterogeneous worship of Krishna, a personal god to whom anyone could pray for succour in distress as one could not to the human teacher Buddha...The sole archaeological datum about Krishna comes from his traditional weapon, the missile discus, a wheel that could be thrown and was sharp enough to behead an enemy. This is not Vedic, and went out of fashion long before the Buddha; but a cave drawing in Mi_rza_pu_r district (the Buddhist Dakkhina_giri, in fact) shows a charioteer attacking the aborigines (who drew the picture) with such a discus. The date would therefore be about 800 BC, roughly the time when the first settlement at Bana_ras was founded. The charioteers would be Aryans exploring the region across the river for iron ore, the rich haematite with which the cave pictures were drawn. On the other hand, Krishna in the Rigveda is a demon, enemy of Indra, his name being the generic designation of hostile dark-skinned pre-Aryans. The basis of the Krishna legend is that he was a hero and later demi-god of the Yadu tribe, one of the five main Aryan people (Pan~ca-jana_h) in the oldest Veda; but these Yadus were alternately cursed or blessed by the hymn-singers according to current alignemnt in the constant fighting between Panja_b tribes. Krishna is also a Sa_tvata, an Andhaka-Vrishni, and fostered in a gokula (cattle-herders' commune) to save him from his maternal uncle Kamsa. The transfer related him, moreover, to the A_bhiras, an historical and pastoral people early in the Christian era, progenitors of the modern Ahir caste..."(pp. 114-116).

Harappan Spoked-wheel

Light vehicles with spoked wheels of the Second millennium (No references to these 'light-weight' vehicles can be surmised from the Rigveda, except in the term, 'rathava_hana', which can also be interpreted as a chariot-stand; the term ara_ used in Rigveda may also connote the three parts of a tri-partite solid wheel of the Tell Agrab type which is dated to the fourth millennium BC).

"...There remains for discussion a problem akin to that which faced us...that of the relationships between the adoption and development of the light vehicle with two spoked wheels, normally horse-drawn, in second-millennium communities of the Near East and of Europe. Whereas a technological progression from fenestrated tripartite disc wheels to cross-bar types seems likely, CHild's view that 'though naturally an expression of the wheel idea, the spoked wheel was a new invention rather than a modification of the tripartite disc' (1954, 214) remains a valid hypothesis. If we accept it, our next step must be to examine the evidence for a place of origin for the new invention, and the alternative, that it could have been independently developed in more than one area where the antecedent condition of domestic horses available for secondary use as tranction animals, was present. The latest statement of the problem is that of Littauer and Crouwel (1979, 68-71). They consider that the Near Eastern evidence they have assembled in exemplary detail 'strongly suggest the possibility of a local evolution of the light, spoked-wheel horse-drawn chariot in the Near East itself, in contrast to the long-held theory that this was introduced from outside in an already evolved form by Indo-European steppe tribes'. They would see the technological genesis of the wheel with nave, felloe and radial spokes, in the cross-bar wheel, both forms being documented from the very beginning of the second millennium BC, with bent-wood techniques also of early origin, together with equid draught with onagers.

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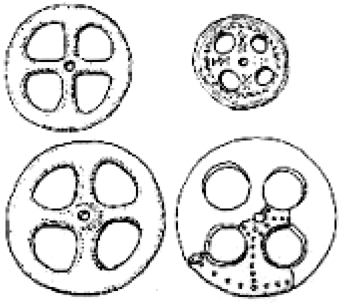
Horses too were becoming familiar to Mesopotamian peoples from equally early in the second millennium BC, and the linguistic and lexical evidence adduced for Indo-European influences is regarded as too late to be relevant to origins. 'Whatever the role of particular peoples in the origin of the spoked-wheeled, horse-drawn chariot, there appear to be no cogent archaeological or linguistic arguments against its development in the Near East itself'. If this thesis were accepted, all the European instances of spoked-wheel vehicles surveyed...from the Urals to Slovakia, would be accounted for in terms of the model of diffusion from 'higher' to 'lower' cultural contexts, from the Orient to EUrope, which Childe developed and maintained so persuasively in the past, and within which we have seen the development of the tripartite disc as best explicable...The writer recently restated the case for an initial development of the light, two-wheeled, horse-drawn vehicle beyond the ambit of the anciet Near Eastern civilizations, and saw its development into the familiar oriental war-chariot as 'the result of a ready social acceptance of the light, spoked-wheel, horse-drawn vehicle from alien, non-urban, non-literate communities to the north...within the natural territory of the wild horse'. This was in the course of an enquiry into the origins of chariotry in Shang China (and incidentally, Vedic India) in the late second millennium BC, and it was suggested that these might better be found in the Timber Grave and Andronovo continuum rather than in the metropolitan ancient Near East itself. (Piggott 1978)...(P.103) (Piggott, S., 1992, *Wagon, Chariot and Carriage*, London, Thames and Hudson).

48 Representation of chariot on pot, mid 2nd millennium BC, from Timber Grave culture burial at Sarator, Lower Volga, USSR



49 Pottery models of spoked wheels, mid 2nd millennium BC, Mad'arovce Větěrov cultures from Slovakia

[After Fig. 48, Piggott, S., 1992, *Wagon, Chariot and Carriage*, London, Thames and Hudson: representation of four-partitioned solid-wheel chariot on pot, mid-2nd millennium BCE.]

Timber Grave culture burial at Sarator, Lower Volga, USSR) (After Fig.49, Piggott, S., 1992, *Wagon, Chariot and Carriage*, London, Thames and Hudson: pottery models of spoked wheels, mid-2nd millennium BCE Mad'arovce Veterov cultures from Slovakia).

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If we restrict the enquiry to the evolution of the spokes in the wheel, the surmise that the tripartite disc yielded the spokes as a next step in evolution of the chariot, is still a valid hypothesis. We have seen that the Timber Grave culture (Sintashta) burial showed not a spoked-wheel burial but a tripartite wheel. (See the pottery models of spoked wheels, mid-2nd millennium BC, Mad'arovce Veterov cultures from Slovakia: Fig. 49 in Piggott, 1992; the models clearly show that it is still the solid disc with the four 'ara_' created by scooping out four segments of the solid block). The Rigvedic description of the chariot delineated in the URLs of this site (from ratha1.htm to ratha8.htm), will match the Tell Agrab model, rather than the European 2nd millennium model.

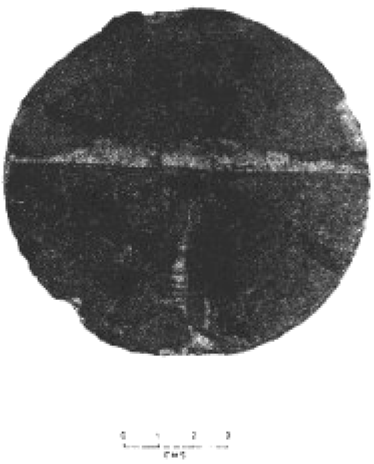

Fig. 9.2 : Terracotta spoked wheel from Kuntasi

The spoked-wheel is a 'sign' of the script of the civilization and is vividly used three times on the Dholavira sign-board

Kuntasi, Gujarat (Harappan site); Fig. 9.2 Terracotta spoked wheel from Kuntasli (about 9 cm. dia) in: Dhavalikar, M.K., 1999, *Indian Protohistory*, New Delhi, Books and Books; "There is no evidence of a chariot like vehicle from any Harappan site so far but for the solitary exception of the Daimabad bronze chariot which can be dated to the Mature phase. It is very light in construction, resembling the Roman biga, with a cross bar at the front. But it too has solid wheels, like those of Harappan clay carts. All the same it shows that the Harappans had chariots. A very important contribution of the Vedic Aryans is supposed to be the spoked wheel. It marks an important technological advance the various developmental stages of which have been traced (Singer 1956: 1.724 ff.). There are only four specimens from Harappan sites which may be taken as models of spoked wheels. One of them is a solid wheel of a terracotta toy cart from Kuntasi which is painted with what look like spokes (Fig. 9.2). They can also be taken as decoration, but look more like spokes. There are similar specimens from Rupar, Mitathal and Lothal (Sharma 1995: 20ff.) all of which are from Late Harappan levels, but there is one from Banavali which comes from the Mature Harappan phase. A spoked wheel also occurs on Harappan seals in an inscription. There are some other knick knacks like the shaft hole axe which has been associated with the Aryans; it occurs at Mohenjodaro and the mid-rib sword from Fort Munroe (Heine-Geldern 1936). The evidence would thus point to the infiltration of certain Aryan elements into the Harappan culture rather surreptitiously and not as a result of an invasion or immigration on a large scale. It has been observed that the evidence for the development of two wheeled war chariot with spoked wheels in West Asia itself is prior to the advent of Aryans in that region. They reached there not before ca. 1600 BCE (Sharma 1995: 20ff) and hence they cannot be said to have introduced this contrivance in West Asia. All this goes to show that the horse, the spoked wheel and the chariot, need not be taken as distinguishing features of the Vedic Aryans and they are therefore not the ethnic markers of Aryans." (pp. 297-298).

Dhavalikar goes on to argue and make many surmises:

"...It is not unlikely that the Aryan culture was not much different from that of the late Harappans. The theory of large scale invasion by Aryans is now discounted as there is no evidence to support it. Theory of migration has been advanced by Renfrew but has nothing to commend itself...The only evidence available is that in the second millennium BCE the Late Harappans had occupied the land of Sapta-Sindhu...According to the Rigveda, various Aryan tribes were occupying the region between the Sarasvati, and the Indus and even in the Sarasvati valley they were in the

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upper courses of the river which was the region occupied by the Late Harappans. Between the Sindhu (Indus) and Vitasata (Jhelum), there were the S'ivas (Sibis) in the north, the Vrichivants in the centre, and the Yadus in the south; between the Asikni (Chenab), and Parushni (Ravi), there were the Druhyus, Turvas'as and Anus; and the region between Parushni and the Sarasvati was occupied by the Bharatas and Tritsus. Among these there were some tribes like Druhyus and Turvas'a who have been supposed to be foreigners and Yadus were supposed to have come from outside. Naturally there were some native tribes as well. According to the RV (Shafer 1954: 17), the Anus, Druhyus, Yadus, Turvas'a and Purus attacked the Aryans of the Parushni. This would indicate that the Aryan tribes were fighting among themselves as any other tribes would do...It appears that there were several Aryan tribes in the land of Sapta-Sindhu which were fighting among themselves and each one abusing the other in derogatory terms like ana_sa, dasyu etc...The pastoral nomads from Central Asia were doubtless coming through the Khyber and the Bolan Pass even in pre-Harappan times. They must have found employment here and got assimilated with the local groups. They in all probability brought with them the domesticated horse, the chariot, the spoked wheel, and such specialised artifacts as the socketed axe-adze which has been found at Mohenjodaro, the Shalozan trunion axe, and the Fort Munroe sword as novelties...Could it be that very soon after they got naturalised and after their assimilation into the pattern of Indian culture, they gave expression to what was already in existence here. We might invoke the Kushan parallel. After the revival of Sanskrit under their patronage, a vast body of religious and philosophical literature of Buddhism came to be produced within a couple of centuries by discarding Pali and Prakrit in which the earlier literature was produced. It is because of this that the religion of the 'Enlightened One' came to be known as Sanskrit Buddhism. It is not unlikely that something like this may have happened in the Late Harappan times. This would then raise the question of the language of the Harappans. Once the Indus civilization was presumed to be the handwork of the Dravidian speakers, Sanskrit became the language of the invaders. But it has never for a moment been thought that Sanskrit, or some form of Prakrit which was very close to it, was probably spoken by the Harappans. This is a distinct possibility in view of the evidence from the S'atapatha Bra_hman.a where occurs for the first time the term mleccha which later came to mean a stranger or a foreigner. But in the beginning it denoted a person who does not speak the language -- that is Sanskrit -- properly. I have elsewhere tried to show that the term mleccha is the Sanskritised form of Meluhha which was the name of India as it is recorded in the Cuneiform documents of the third millennium. Ths S'Br. is generally dated to the beginning of the first millennium BC, and it is quite likely that it records the events of a still earlier period (Dhavalikar 1997), in this case, of the late second millennium BCE. This is the time when the Late Harappan cultures were breathing their last. In fact they have vanished from many areas but small pockets may have survived in some places...I lay no claim to have solved the (Aryan) problem; far from it...As has been observed, this was the time period and the region where the Late Harappans were living. It may then be asked whether the Late Harappans were Vedic Aryans? The answer is not simple, but the possibility cannot be ruled out."(pp. 299-301).

“So far as wheeled transport goes, the ancient Sumerians shared with those other peoples, from Neolithic Europe on the west to the bronze-utilising civilization of the Indus Valley to the east, the use of the ox-drawn wagon or cart from the beginning of the third millennium BCE. That ox-wagons could, as on the South Russian steppe, play a symbolic role in the burials of an upper stratum of society, reflecting as carriages for the living, is shown by the remains of disc-wheeled wagons and bovid skeletons in princely tombs of Early Dynastic III date, c. 2500 BCE, in the Ur Royal Cemetery (Grave PG 580: four bovids and a probable vehicle; PG 780: 6 bovids and two four-wheelers; bovids uncertainly with Puabi’s throne sledge in PG 800) and again at Kish and Susa less well recorded…

“The Sumerian, from the end of the third millennium BCE, show the use of a generic ‘equid’ word, **anse** covering asses and their hybrids, onagers and horses, distinguished by qualifying epithets in which for instance ‘equid of

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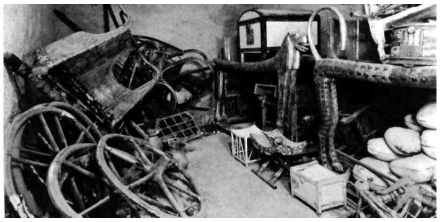
the desert' denoted an ass or donkey, and 'equid of the mountain' meaning a horse, reaching the Mesopotamian plain from the mountainous north…Sumerian seems to have had two main vehicle words, one **mar-gidda** for a four-wheeled draught wagon (**eriqqu** in Akkadian), and the other **gigir**, a general all-purpose vehicle word but especially for one with two wheels, the cuneiform character for which shows a stylized disc wheel. In Akkadian this was equated with another all-purpose word from a Semitic 'conveyance' root, **narkabtu**, which then became specialized as a chariot, invariably horse-drawn, whereas the Akkadian heavy-duty wagon, **sumbu**, was drawn by mules or, as traditionally, oxen. With **narkabtu** then, we come to the beginning of one of the great chapters of ancient history; the development of the light two-wheeled chariot drawn by paired horses as a piece of technology and as an institution within the socil order as an emblem of power and prestige….Behind this (narkabtu) is the root **rkb**, a 'conveyance' word, appearing in Ugaritic **mrkbt**, and when Egypt took up the chariot package-deal from Mesopotamia and Syria in the seventeenth century BCE, it adopted as a loan-word **mrkbt** for a chariot. In the Levant versions of the same word later appear in Hebrew and Aramaic and it is perhaps significant that Arabic, the language of a people who had from the first repudiated wheeled transport for the camel, uses the same root for both land vehicles and ships: the tired old metaphor fo the 'ship of the desert' is literally simply a conveyance on land. (S. Salonen, *Studia Orientalia*, XIV.2., 1950, 1-8; *Landfahrzeuge*.., 1951)." (Stuart Piggott, Wagon, 1992, *Chariot and Carriage: Symbol and Status in the history of transport*, New York, Thames and Hudson, pp.37-41, p. 50).

In Avestan, a warrior is known as rathae_s'tar, i.e. 'chariot rider'. Mary Boyce notes " (rathae_s'tar).. a term evolved evidently after the Iranians had adopted the war-chariot instead of fighting on foot. This development is held to have taken place during the second millennium BCE; and so popular did the chariot become that in time most of the gods of the Iranians and Indians came to be conceived as driving in one. Zoroaster himself seems to have made use of a wheeled vehicle in his jouryings; but the vocabulary of his poetry still reflects an older state of affairs, when probably the weak and old traveled in heavy ox-drawn carts, and men would have made their way, and fought, on foot."(Mary Boyce, 1996, *A history of Zoroastrianism*, Vol. I, Leiden, EJ Brill, p. 6; See Stuart Piggott, *Prehistoric India to 1000 BCE*, 2nd ed.n, London, 1962, 268-9, 275-83; A Kammenhuber, *Hippologia Hethica*, Wiesbaden, 1961, 10 f.; RA Crossland, *Cambridge Ancient History*, 3rd ed., I 2, 1971, 873-4; DM Lang, *Armenia*, London 1970, 82-3; See Yasna 51.12; Bartholomae, *Air. Wb.* 1417, that **va_za_** is dual for 'two draught-animals').



Kikkuli, the horse trainer, called himself in his Hittite horse training manual **assussani** which is comparable to Sanskrit **asvasani**. He also uses Sanskrit terms to indicate the number of laps run by the horses in daily training; this indicates the presence of a Sanskrit-speaking group among early Hurrian Mitanni with technical terms transmitted to Hittites. Semitic Akkadian renders horse as **assisu**. "The intimate linkage between Proto-Indo-Europeans and the horse and chariot is a myth. As long ago as 1957 the linguist Ronald Crossland wrote that 'archaeologists now doubt whether the Indo-Europeans already had the chariot, as distinct from heavier vehicles which could have been drawn by oxen. There is no inherited word for it, or for any part of it which a cart could not have, and there is no philological proof that any Indo-Europeans had it before c. 1450 BCE.'(RA Crossland, 1957, 'Indo-European origins: the linguistic evidence', *Past and Present*, 12, 16-46). And more recently, Mllory has quoted the Russian historian Igor Diakonov as seeing 'no case for employing the first appearance of the domestic horse and chariot as an ethnic marker for Indo-European

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migrations'. (JP Mallory, 1989, *In Search of the Indo-Europeans*, 41). As for the Indo-European 'homeland' and the wild horse, the fact that they may have coincided or overlapped may be no more than a zoogeographical accident…The vehicle (Vedic chariot) seems to have been of normal Near Eastern type and was known as **ratha**, a wheel-word cognate wih Latin **rota** or German **rad**; for the wheel itself another Indo-European alternative was used, **cakra** (Greek **kuklos**, English '**wheel**')…Akkadian texts…**mariannu**, 'primarily as a noble who is a chariot-warrior'…a loan-word from Indo-Aryan with the sense of 'young man'." (Stuart Piggott, 1992, pp. 51-52, 55-57).

Dismembered chariots in the tomb of Tutankhamum at Thebes, c. 1440-1330 BCE. [After Pl. 3 in: Stuart Piggott, 1992]. The wood used for making chariots in the tomb of Tutankhamum at Thebes (mid-fourteenth century BCE) has been identified as: tamarisk (locally available), elm and birch-bark (possibly imported from temperate woodlands of north Syria and Anatolia)."The contemporary Mycenaean Greek documents mention elm, willow and cypress, and the very late, immediately pre-Roman, northwest rueopean and British finds of wheels of chariot type include elm, ash, willow and hornbeam in their structure." [cf. S. Pitgott, 1983, *Earliest Wheeledd Transport*, 28; MA Littauer and JM Crouwel, Chariots and related equipment from the tomb of Tut'ankhamu_n, Oxford, 1985; Stuart Piggott, Wagon, 1992, *Chariot and Carriage: Symbol and Status in the history of transport*, New York, Thames and Hudson, p.45].

In contrast to these woods used for light-weight chariots, RV 3.53.19 refers to the use of heavy, hard woods: khayar and s'is'u: khadirasya sa_ram is the text; khadira = *mimosa catechu* of which the bolt of the axle is made; while the s'im.s'apa, *dalbergia sisu* furnishes wood for the floor; these are still timber-trees in common use. The aks.a (axle) was made of 'arat.u' wood (RV 8.46.27).

Discussing the question of origins of the two-horse chariot, Roger Moorey notes: 'No single ethnic or linguistic group seems to have been the master innovators in the history of horse-drawn light chariotry in the Near Eastern Middle Bronze Age. A diversity of peoples and circumstances more probably explain the gradual incremental change evident in the available, albeit inadequate, range of evidence.' (PRS Moorey, 1986, 'The emergence of the light horse-drawn chariot', *World Archaeology*, 18.2, pp. 196-215). Mary Littauer and Joost Crouwel have argued for the local evolution of the light, spoked-wheeled, horse-drawn chariot in the Near East itself, and not, an introduction from the northern steppe areas. They also note that the spoked wheel evolved from the 'cross-bar' type tri-partite solid wheel from the late third millennium BCE shown on seals from Tepe Hissar in Iran and c. 2000-1850 BCE at Kultepe in Anatolia. (MA Littauer and J. Crouwel, 1979, *Wheeled Vehicles in the Ancient Near East*, 68, 99).

("Third Millennium. "...different types of axes: single, double-bladed, or fenestrated, they functioned as ritual, ceremonial, and currency-exchange objects, in addition to military usage. Various knives, spears, daggers, slings, and throwing-sticks were also used...The Stela of the Vultures from Lagash (circa 2500) portrays a very tightly formed phalanx of foot soldiers with overlapping spears held horizontally and with rectangular shields, and this sculpture is the clearest evidence from the period for battle formation. It suggests a highly trained and disciplined force...Two main types of chariots are known: the four-wheeled 'battle-car', conveying a spear-thrower, and the two-wheeled chariot, which may have been developed for the hunt. Since horses seem to be unknown in Mesopotamia until the end of the third millennium, some other kinds of equid--perhaps onagers--acted as draft animals. The vehicles were very heavy: their wheels were of solid timber, perhaps banded with tires of rawhide, metal or wood. The axles were

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probably fixed to the wheels and so rotated with them. The draft pole was straight, and fixed very low down at the front. Such vehicles cannot have been either swift or maneuverable; they appear to belong always to men of very high status. Indeed, it may in marking status that their importance lies, rather than as a practical asset in war...(Horses seem to have appeared in Mesopotamia around the end of the third millennium.)...The Second Millennium...War was a seasonal activity: many workers were allowed to cultivate palace ilku-land (state-owned fields farmed in return for a share of the produce; the right to farm them could be inherited, but carried the duty of military service) in return not only for a tithe of produce but also for duties that included military service and corvee work, especially on canals...Kassites, whose origin may lie in the mountains to the northeast of Mesopotamia, formed enclaves within Babylonian cities and put their specialist skills as horsemen at the disposal of native Akkadians; during this time the horse was bred and trained in Mesopotamia. Certain technical developments made the chariot a slightly more viable vehicle for battle: the spoked wheel was invented, perhaps in Syria, and lightened the whole. Although the bridle still controlled the horse by means of a nose ring at the beginning of this period, the mouth bit, at first rigid and then soon jointed, emerged to give a far easier control. Kings and persons of very high status began to be shown shooting with a bow and arrow from their chariots, which seem to have served as mobile firing platforms in battle, helping to disrupt putative lines off infantry and picking off stragglers...The Amarna and Middle Babylonian Periods...Battle chariots regularly had two wheels, mostly with four spokes (although six, eight and nine are also known), and were drawn by a pair of horses, with one or two more running beside them as outriggers. A chariot-owning aristocracy arose, known as *mariyannu/martianni* which is thought to come from a word of Indic origin. Aryan involvement is confirmed by a horse-training manual found in the Hittite capital Bogazkoy (ancient Khattusha), in which many technical terms are given in an Aryan language related to Sanskrit. The charioteers were based on the palace, and individual terms for officers are often identical with terms for court officials. Warfare was more international than before: the Semites and Hurrians of Mesopotamia met Hittites and Egyptians on battlegrounds in Syria, the country which appears to have led in technical developments. The time and expense involved in training and equipping for the chariot-owning aristocracy was such that soldiering became a more professional, hereditary occupation which affected activity all year round even though campaigns remained seasonalStephane Dalley, 1995, Ancient Mesopotamian Military Organization, in: Jack M. Sasson (ed.), *Civilizations of the Ancient Near East*, Vol. III, pp. 413-422).

A remarkable evidence of the use of inscriptions on weapons comes from ancient Anatolia, attesting to the advances in Hittite metal and armour industry.

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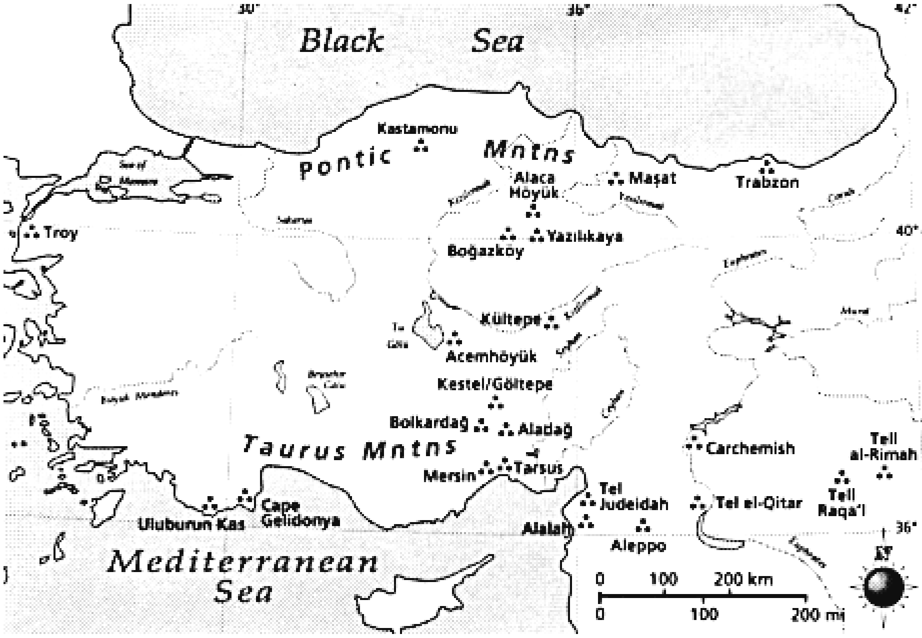

Archaeological sites of early and late bronze age in Turkey. “Current understanding of Hittite metallurgy comes from metal assemblages excavated from several Late Bronze Age sites such as Bogazköy, Masat, and Alaca Höyük. A partial list of these assemblages includes metal armor, weapons, pins, tool, wagons, figurine, seals, and treaties…A recent hoard found near Kastamonu produced other examples of ritual iconography in metal: plates engraved with hieroglyphic inscriptions and decorated with registers in relief of griffins; trees of life, combat scenes with lions and bulls; lions and lions; and hunting scenes (Emre and Cinaroglu 1993). Moreover a fragment of an oxhide ingot of copper excavated at Bogazköy (Müller-Karpe 1980) links this seemingly landlocked empire with a circum-Mediterranean maritime commerce. ..The quantities of metal objects with ritual significance began early, as the findings at Troy and Alaca Höyük demonstrate. Weapons are prominent members of this grouping. Two examples from the Middle Bronze Age are a bronze spearhead engraved with inscriptions of Anitta the King and a sword dedicated to the god Nergal (Güterbock 1964). Engraving inscriptions onto metal continued into the Hittite period. A sword with an Akkadian inscription celebrates Tuthaliya II's victory over the western Assuwa-land (1430 BCE). The inscription dedicated the sword to the storm god (Ertekin and Ediz 1993, Ünal 1993). Another example of a numinous weapon is a spearhead inscribed *walwaziti* ,"Great scribe," probably dating to the reign of Hattusili III and Queen Puduhepa (Bilgi and Dincol 1989). Swords and axes were decorated with human, animals, and fantastic divine creatures. These weapons have a smooth background from which figures stand out in relief their forms are reflected in the Hittite relief depicting the Dagger God at Yazilikaya, which may have been based on a metal prototype. Its hilt is shaped like a god's head framed by four lions (Bittel et al. 1941). In addition to weapons, treaties were cast in metal. Recent excavations at Bogazköy revealed a bronze tablet inscribed with a treaty between Tuthaliya IV and Kurunta, King of Tarhuntassa (Otten 1988; Houwink ten Cate 1992).” [K. Aslihan Yener, Swords, Armor and Figurines: http://www-oi.uchicago.edu/OI/PROJ/GOL/BA_95/BA_95.html]

In the treaty between the Hittites and Mitanni, the Mitanni king swears by: Mi-it-ra (Indic Mitra), Aru-na (Varun.a), In-da-ra (Indra) and Na-sa-at-tiya (Nasatya or As'wins).

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A Hittite text on horse-training and chariotry, written by Kikkuli (a Mitanni) uses Indic numerals to indicate the number of turns made by a chariot on a track: aika (India eka 'one'), tera (tri 'three'), panza (panca 'five'), satta (sapta 'seven') and na (nava 'nine').

Opening instructions from the Hittite text on horse-training by Kikkuli the Mitanni. In order to describe Kikkuli's profession, the text employs the Indic word assussanni (Skt. asvasani-).
'Thus (speaks) Kikkuli, the assussanni (the horse-trainer), from the land of Mitanni: When he lets the horses onto the meadow in the autumn, he harnesses them. He lets them trot 3 mails, but he lets them gallop over 7 fields. But on the way back he has them gallop over 10 fields. Then he unharnesses them, provides for them, and they are watered. He brings them into the stable. Then he gives them mixed together 1 handful of wheat, 2 handfuls of barley and 1 handful of hay. They eat this up. As soon as they have finished their fodder, he binds them close to the post.'

Archaeological evidence for the horse. Gorgan region southeast of the Caspian shows the first appearance of a domesticated horse about 3000-2250 BCE. Surkotada in the Rann of Kutch, Gujarat, India has yielded bones of the horse, dated to mid-third millennium BCE. Tal-i Iblis in south-central Iran (3500 BC) and Selenkahiyeh in Syria (2400-2000 BC) also attest the presence of the horse. There is a cylinder seal depicting a horse-drawn vehicle excavated from Hissar IIIB. Linked with the evidence of the Mitanni horse-trainer, Kikkuli's horsemanship manual, the migratory route for the Indics would appear to have been through Hissar to Mesopotamia. There is a possibility that the spoked wheel for the chariot was an indigenous development within Mesopotamia, as an evolution from the two-wheeled onager-drawn cart into a spoked-wheel chariot drawn by horses prior to ca. 1600 BCE. The incorporation of the indic elements in Mitanni should have taken place centuries prior to 1600 BCE.

Pirak, Baluchistan, ca. 1000 BCE. Geometric seals in terracotta and bronze. [After Fig. 9.12 in JM Kenoyer, 1998].

Horse. "A terracotta figure found by Mackay in his excavations at Mohenjo-daro was identified by him as that of the horse. This identification has been accepted by many but not all. However, in recent years a lot of new light has been thrown on the issue. Lothal has yielded not only a terracotta figure of the horse but also the second right upper molar of that animal. To recall what Bholanath of the Zoological Survey of India has stated, the tooth 'resembles closely with that of the modern horse and has pli-caballian (a minute fold near the base of the spur or protocone) which is a well distinguished character of the cheek of the horse' (in S.R. Rao 1985: 641). Surkotada has yielded quite a few bones of the horse, which have been identified as such not only by A.K. Sharma but also by Sandor Bokonyi, an internationally recognized authority on the anatomy of the horse. To repeat one of his significant observations; 'The occurrence of true horse (equus caballus L.) was evidenced by the enamel pattern of the upper and lower cheek and teeth and by the size and form of incisors and phalanges (toe bones). Since no wild horses lived in India in post-Pleistocene times, the domestic nature of the Surkotada horses in undoubtful.' Horse remains have been identified at Kalibangan too; and Bholanath

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also states that an earlier collection from Harappa examined by him did contain remains of the true horse. However, no horse-bones have so far been reported from the current excavations at the site. Finally, attention must be drawn to the discovery of terracotta figurines of the horse by Jarrige and his colleagues (in press) in the Harappan levels at Nausharo in Pakistan." (B.B. Lal, 1997, The Earliest Civilization of South Asia, New Dehli, Aryan Books International, pp. 285-286).It is a debatable issue if the appearance of the horse and the chariot can be treated as an ethnic marker for the Indic speaking peoples.

Another Hurrian text from Yorgan Tepe uses Indic words to describe the colour of the horses, for example, babru (Indic babhru 'brown'), parita (palita 'grey') and pinkara (pingala 'reddish'). The Mitanni charioteer is called marya (Indic-Vedic marya 'warrior, young man'). Added to these are a series of names of the noblemen or aristocracy of Mitanni which are clearly Indic. The conclusions are: "an element of Indic-speaking chariot warriors superimposed themselves on a native Hurrian-speaking population to form a ruling dynasty that endured for several centuries...there are also possible (though disputed) Indic traces in the names of a few gods revered by the Kassites (Surias and Marytas: i.e. Su_rya and Maruts)...By the thirteenth century the Mitanni kingdom collapses which sees an end to the Indic presence in Southwestern Asia..." (J.P. Mallory, opcit, 1989, p. 38).

"We cannot reconstruct Proto-Aryan religious terms--and much less Proto-Aryan religious ideas--by simply and naively projecting Rigvedic data into Proto-Aryan times. A reconstruction can be attempted only by a careful confrontation of Vedic and Avestan terminology'. (P. Thieme, 'The 'Aryan' gods of the Mitanni treaties', *JAOS*, 80, 1960, 301-317). The same conclusion was argued by Sten Konow (*The Aryan gods of the Mitani people*, Christiania, 1921).

"It is now generally agreed by most authorities on the subject that the Aryan linguistic vestiges in the Near East are to be connected specifically with Indo-Aryan, and not with Iranian, and also that they do not represent a third, independent Aryan group, and are not to be ascribed to the hypothetically reconstructed Proto-Aryan. This conclusion is incorporated in the title of M. Mayrhofer's bibliography of the subject, *Die Indo-Arier im alten Vorderasien* (Wiesbaden, 1966), and it can now be taken as the commonly accepted view. It is based on the fact that where there is divergence between Iranian and Indo-Aryan, and where such elements appear in the Near Eastern record, the latter always agrees with Indo-Aryan. Such items are aika 'one' and s'uriyas' 'sun' and the colour-names parita-nnu and pinkara-nnu which correspond to Sanskrit palita- 'grey' and pingala 'reddish' .

"...the name of the capital of the Mitanni state, Was's'ukanni...we should see in the first member a noun vasu 'wealth', and not an adjective vasu- meaning 'good' as in Iranian (Av. vohu-). In this case the second element is obviously khani- 'mine', the whole meaning 'mine of wealth (i.e. precious metals)', and this explanation provides the motive which attracted those Proto-Indoaryans to this region. It was an age when prospecting for metals, precious or otherwise, was being actively pursued, and the Aryans were as much interested in this activity as anybody else. It is understandable that when it came to their knowledge that a new and large deposit of such materials has been found, it would stimulate them to attempt to get control of that territory...

"...the division of Proto-Aryan into two branches, Indo-Aryan and Iranian, must have taken place before those languages were established in their eventual homes, and not merely be due to developments which took place within each of the two groups after the Indo-Aryans had settled in India and the Iranians in Iran. This conclusion could only be shown to be wrong if it could be shown that the Vedic Indians, having migrated all the way to the Punjab from their earlier home, had then retraced their steps and undertaken yet another migration in the direction of the Near East. Konow was prepared to believe this, but there is no evidence for it, and it seems that a theory involving such complication can be safely ignored...A further conclusion from this is that the

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date of the Proto-Aryan period must be pushed back further than has often been thought, and probably it cannot be brought down below 2000 BC, at the latest.

"...The identification of the Aryan traces in the Near East as Proto-Indoaryan has, in Thieme's words, 'considerable historical implications'...

"...Sarasvati_ is in the first place the Proto-Indoaryan name of the river in Iran, which after the migration was transferred to the river in India. The Iranian name (haraxvaiti_) is a loan word from Proto-Indoaryan, with a substitution of h- for s-, occurring also in hindu-..Another case is the river name sarayu_, which was transferred from Iran (haraiva-/haro_yu_) to a river in North-West India, and then again from there to a tributary of the Ganges in eastern India...

"...Of the four divine names mentioned in the Mitanni treaty...Varun.a would remain exclusively Vedic...There is, however, no reason to believe that Indra and Na_satya ever belonged to the Iranian religious tradition...They are gods which were being worshipped by the Proto-Indoaryans in eastern Iran when Iranians gook over the country...The geographical horizon of the Avesta is almost exclusively eastern Iranian...but eventually the defences of the Proto-Indoaryans to the west were overcome, and this was followed by massive Iranian immigration into central and western Iran...

"The usually accepted date of Zoroaster is based on a tradition dating from Sasanian times which places him 258 years before Alexander...very influential scholars have adopted it, notably A. Meillet in 1925 and W.B. Henning in 1951 (A. Meillet, *Trois conferences sur les Ga_tha_s de l'Avesta*, Paris, 1925; W.B. Henning, *Zoroaster*)...The conclusion that the old Yas'ts and in particular the Fravardin Yas't are to be dated before the migration of the Iranians to central and western Iran provides a basis for calculating the date of Zoroaster, since we can begin from the earliest mention of the Medes and Persians in the Assyrian annals, which occurs in the second half of the ninth century BCE(Parsua 844 BC, Madai 836 BC)...If we take the hundred years between Zoroaster and Sae_na and add them to the period represented by the four generations from Sae_na to Utayutay, we arrive at a period of 200 years at the very minimum between Zoroaster and the composition of the Yast. Adding this to the date 900 BCEsuggested above as the time of the movement west of the Iranians, we obtain 1100 BCEas the lowest possible date for the founding of the Zoroastrian religion...We may conclude the Iranian conquest of eastern Iran was an event that took place not later than the fourteenth century BCEand it thus coincided with the period when the Proto-Indoaryans had their furthest extension westwards. At this time large numbers of Indo-Aryans had migrated into India, and as a result of these two migrations the position of the Proto-Indoaryans in their original base in eastern Iran must have been considerably weakened, thus providing the Iranians with an opportunity to move in and take over.

"...Since the Proto-intoaryans must have been in north-western Iran in order to reach the Mitanni country, it will not be unreasonable to suggest an Indo-Aryan etymology for this name (Lake Urmiya), if one is available. Such an etymology is available if we compare Skt. u_rmi- 'wave' and u_rmya- 'undulating, wavy' which would provide a suitable descriptive name for the lake. This is a case where the phonology of Indo-Aryan and Iranian have diverged quite widely (cf. Av. varemi- 'wave') and it is interesting that the name of this lake, if the above etymology is correct, should go so clearly with Indo-Aryan." (T. Burrow, The Proto-Indoaryans, *JRAS*, 1973, No.2)

Burrow provides no linguistic basis for his hasty assumption that Sarasvati is a proto-Indo-Aryan name of a river in Iran: *haraxvaiti_* with the substitution of *h-* for *s-*. The name could have been derived from River Sarasvati in north-western Bharat, after the people migrated westwards, away from River Sarasvati, after the desiccation of the river started.

Hurrian

In Mundarica, hor means a 'man'. In Tamil, kor-r-am means 'victory, power, sovereignty'.

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"The major Semitic languages, other than Akkadian, derive their usual word for 'free' from the root |h.rr. Vullers, in his article 'Uber die Rassenfarben in der arabischen Literatur' (Centenario della nascita di Michele Amari I, Palermo, 1910, 84-95), connected this with |h.rr, 'hot, buring', and with |h.wr, 'white'. The underlying concept, Vullers argued, has to do with fire and light...Vullers imagined the ancient history of the Near East to have been similar to that of India where the (presumably) dark-skinned original population was subjugated by Aryan invaders from the North. There is, however, no evidence for such a state of affairs in the lands inhabited by Semitic speaking peoples. Nonetheless, and despite the blatant racism underlying Vuller's whole line of argumentation, one cannot rule out some sort of semantic connection between the concepts 'white/bright/light' and 'free/noble'... The other occurrences of |h.rr in Achaemenian Aramaic are the h.ry yhwdy (or yhwd), the 'freemen/nobles of the Jews/Judaea', in two documents from Elephantine (A. Cowley, *Aramaic papyri of the fifth century BC*, Oxford, 1923, no. 30: 19, 31:18)...Persian wuzurga_n ud a_za_da_n, 'magnates and nobles', corresponds to Syriac rawrba_ne_ w-h.e_re_, but h.e_re_, 'nobles' occurs by itself in entirely non-Persian contexts, see for example the bnay h.e_re_ of Nagra_n (South Arabia) who are mentioned repeatedly in the Book of the Himyarites. (A. Moberg, *The book of the Himyarites*, Lund, 1924). Hebrew h.o_ri_m occurs 13 times in the Old Testament...In all of these instances the English Authorised Bible has 'nobles' and in most cases we clearly have to do with dignitaries of some sort (e.g. the 'nobles and rulers', ha-h.o_ri_m we-ham-mega_ni_m, in Neh. 2,4,4,5,7)...For Arabic h.urr the dictionaries give (1) 'free'; (2) 'liberal, generous, frank, etc.'; (3) 'noble'.. Ancient South Arabian has h.r, plural, 'h.rr, feminine plural, 'h.rrt, 'freeman/woman'...then the special development represented by Geez h.ar(r)a_wi_, 'soldier', and h.ar(r)a_, 'troops', which do not seem to have left any traces in the modern Ethiopic languages." (Francois de Blois, 'Freemen' and 'Nobles' in Iranian and Semitic Languages, *JRAS*, 1985, No. 1).

Enumerating divinities in treaties

"There was a tendency to enumerate a maximum of gods and godesses able to safeguard the implementation of oaths...An interesting example is the list of deities in the treaty between Suppiluliumas, king of the Hittites, and S'attiwazza, king of Mitanni: from the Hittite side the gods of the empire are invoked...Most of them are Hattic but some are Indo-European (thus, along with the Hattic Sun-godess of Arinna the Hittito-Luwian Sun-god is also mentioned), or Hurrian (thus, the Thunderer-god has been identified with the Hurrian Tes's'ob...and by the Hurrian mountain-gods 'south and north' (Nanni and Hazzi); moreover included in the list are seventeen Thunderer-gods, differentiated either according to the sphere of life which each of them patronizes or according to their places of worship...From the Mitannian side the deities are divided into three groups: (a) the gods of Kizzuwadna, (b) the gods, presumably of Harra_n (anyway, Semitic gods), (c) Mitanian gods proper...Group (c) includes also a mention of certain Indo-Iranian gods (probably protectors of the dynasty): there is a Hurrian sentence wedged into the Akkadian text: 'the Mithraic gods, the Varunian (?!) gods (the original has 'Urwanian (or 'Arunian') gods'; Urwana- and Aruna- are hard to explain from the Hurrian), Indra, the gods Na_satya'. Further, it includes a number of Akkadian gods firmly rooted in most Hurrian pantheons." (Diakonoff, I.M., Evidence on the Ethnic Division of the Hurrians, in: M.A. Morrison and D.I. Owen (Eds.), Studies on the Civilization and Culture of Nuzi and the Hurrians, Eisenbrauns, Winona Lake, Indiana, 1981pp. 77-89).

The oldest cuneiform spelling is Ma-i-ta-ni, used by S'uttarna I (S. Smith in Antiquaries Journal XIX 42); later the name is written variously as Mi-i-it-ta-a-an-ni, Mi-i-it-ta-an-ni,

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Mi-i-ta-a-an-(ni), Mi-i-ta-an-ni; the Egyptian form Mitn is found in inscriptions of Thutmose III (1490-1436). The state of Mitanni was populated mostly by Hurrians and was ruled by kings whose names indicate that they had Indo-Aryan origin. The nobility, marianni, were also Hurrians. Tus'ratta called himself 'the Hurrian king'. Bogazkoy documents refer to the people of Mittanni as Hurrian. In the first half of the first millennium BC, Hurrians are restricted to the area between northern Mesopotamia and Lake Van.

In the ancient Near East, the custom was to name (first-born?) children after their grandparents. This custom is also well-known in ancient India. In Tamil language, pe_ran- (lit. the one having the same name) means a grandson. (Ignace J. Gelb, 1944, *Hurrians and Subarians, Studies in Ancient Oriental Civilization No. 22,* Illinois, University of Chicago Press, p. 79).

Hurrians are only one among several ethno-linguistic groups present in significant numbers in Mesopotamia in early second millennium BCE. In Hurrian, huradi means a soldier; in the neo-Assyrian period, a verb hara_du 'to keep watch' was perhaps derived from it. Many persons with Hurrian names are listed as having occupations: scribes, chariot-builders, leather-workers, farmers (is's'akku_), fisherman, weavers, and musicians (naru_). For over a century (c. 1350-1225 BC), Hurrians formed a notable minority within the population of Babylonia, particularly in the south central area around Nippur. (J.A. Brinkman, Hurrians in Babylonia in the Late Second Millennium BC), in: M.A. Morrison and D.I. Owen (Eds.), *Studies on the Civilization and Culture of Nuzi and the Hurrians*, Eisenbrauns, Winona Lake, Indiana, 1981).

The art on cylinder seals of the Mitanni is an appropriation of the conventions of their adopted homeland, Mesopotamia, from the late third to the late second millennium BCE. and paralleled in the cylinder seals of the Sarasvati Sindhu Civilization. In Mitanni, the lion is the main opponent in the contest motifs of all periods. Leopard becomes an opponent in the late period in Mesopotamia. The lion's original victim in the conflict between the wild and the domesticated is the bull. It is the bull which the hero is called upon to protect. Later, the bull also becomes an opponent.

Aryan names found in Mesopotamia, Syria and Palestine are attributed to Mitanni influence: s'uvardata (*svarda_ta 'given by heaven'; s'atuara (*satvata = satvan 'powerful, victorious: a warrior), artamanya (r.tamanya 'thinking on th elaw'), biridas'va (vr.ddha_s'va 'possessing large horses') biryawa_za (vi_ryava_ja 'having the prize of valour'), indarota (indrota (RV) 'helped by Indra), s'ubandu (subandhu). In the Kassite documents there is a list of names of gods with Babylonian equivalents: s'urias' (rendered s'amas') equated with Sanskrit 'su_rya. Maruttas' the war god (rendered En-urta) is compared with Sanskrit marut. Among the kings of the Kassite dynasty (ca. 1750-1170 BCE, apparently originating in the mountainous regions of western Iran) is a king names abirattas' (abhi-ratha 'facing chariots (in batle)'. (T. Burrow, *The Sanskrit Language*, London, Faber and Faber, 1955).

Mitanni glyptic art tradition has parallels only in Mesopotamian and Harappan

The second millennium cylinder seals of Mitanni, both from east and west of the Mitanni empire, i.e. from Nuzi and Alalakh, show glyptic art motifs of Babylonia, either directly or through what is called Syrian glyptic.

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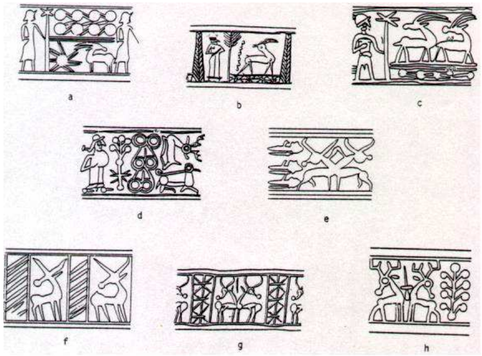
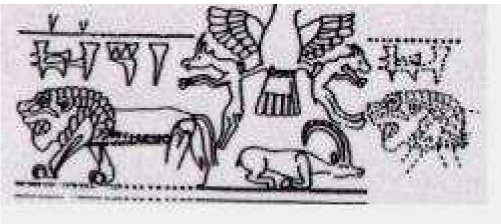


Cylinder seal impressions: (a) Nuzi (D. Stein); (b) Ugarit (Schaeffer-Forrer 1983); (c) Alalakh (Collon 1982); (d) Alalakh (Collon 1982); (e) Nuzi (D. Stein); (f) Nuzi (D.Stein); (g) Ugarit (Schaeffer-Forrer 1983); (h) Alalakh (Collon 1982).

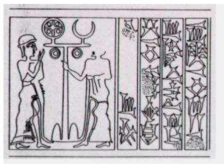
The styles are: juxtaposed antelope, humans and trees framed by geometric patters. The styles have prehistoric roots in Mesopotamia and glyphs such as an antelope with its head turned, jointed animal heads are also seen in Harappan inscription motifs.

Cylinder seal impression of Idrimi of Alalakh (Collon 1975); Legend: Idrimi, servant of IM; the seal was used by Idrimi's son, Niqmepa. Secondary scenes of opposing animals and dimunitive motifs with wings are on superimposed registers divided by a spiral (guilloche) pattern.

Cylinder seal impression of Niqmepa or



Ilimilimma (Collon 975); Legend: ...(?), Niqmepa. The heraldic composition of Saus'tatar's seal occurs at Alalakh on this seal of Niqmepa or his son, Ilimilimma.



Cylinder seal impression of Ithiason of Kipi-tes's'up (Drawn by D. Stein); Legend: Ithia king of Arrapha son of Kipi-tes's'up; this is noted as early eastern court style: full-scale figures interspersed with filler motifs.

Urkesh norther Mesopotamian city; bronze lion protome; New York Meropolitan Museum of Art; two bronze lion protomes protected the foundation tablets of the temple dedicated to Nerigal by the Hurrian king Tis'ata end of third millennium BC; inspiration seems to be from the Mesopotamian tradition of lion representation particularly in Akkadian art.

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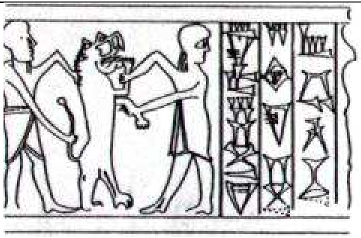
Cylinder seal of Tehes'-atal the scribe (British Museum); Legend: Zabazuna strong king:

Tehes'-atal the scribe is your servant).

The seal is modelled on Ur III presentation scenes of the 'Arad-zu' type, in which a worshipper stands before the seated king. On this seal, the king is seated on a throne rather tan the usual padded stool, one of the worshippers is not bareheaded and neither raises his right hand, as on the metropolitan prototypes. (Diana L. Stein, 'Art and Architecture', in: Gernot Wilhelm, *1989, The Hurrians*, trans. by Jennifer Barnes, Warminster, Aris and Phillips Ltd.).

Lapis lazuli Cylinder seal of Zardamu King of Karahar (British Museum); Karhar is on upper Diya_la near the Zagros foothills;

Legend: Zardamu, Sun-God of his land; beloved of Nergal, his god; Annunitum, his mother; S'ul-pae, his...; [of DN], his...; En-sig-nun, who walks on his right; ...of S'amas', his? Tammuz; strong king, king of Karahar and king of the Four Parts, spouse of Is'tar. The iconography harks back to the famous victory stele of Naram-suen in the Louvre. "In the tradition set by this Akkadian king and revived by the rulers of the Ur III Dynasty, Zardamu describes himself as divine king of the Four Quarters of the Earth (Sollberger 1980) and depicts himself in ascending posture, trampling on his fallen enemy.



Cylinder seal impression of S'uttarna, son of Kirta (Collon, 975); Tell Atchana (Alalakh IV), Turkey.

Impressions on tablets AT 13,14. Legend: Suttarna, son of Kirta, King of Maittani; two lions are defeated by a central single human-headed lion-demon in bird costume; worn and recut, the seal is used as a dynastic emblem by Saus'tatar in mid second millennium BC; two tablets found in Alalakh which record judicial decisions taken by Saushtatar are authenticated with the 'dynastic seal', which bears the legend' S'uttarna, son of Kirta, king of Maitani'. The seal reflects the style of Post Akkadian and Ur III periods (Collon 1975). "The contest scene, first introduced as a frieze of overlapping figures during the Early Dynastic period, is epitomized at the height of the Akkadian period as a symmetrically composed conflict between balanced pairs of protagonists. Long associated with kingship, this theme developed into the three-figured struggle depicted on the seal of S'uttarna, in which an animal victim is pitted against two human assailants (Collon 1982: 111). The seal was used as a dynastic seal by Saushtatar of Mitanni in about 1450 BCE; it was probably originally cut in the late 3rd millennium BCE but was subsequently recut along the lines of the original design and a new inscription was added. Antakya and BM; Collon, 1975, No. 230.

Towards the middle of the 2nd millennium BCE, a new material for seals arrived. This was sintered quartz, also known as composition (or, less accurately, as faience, frit or paste). This composition is often used in the beads and seals

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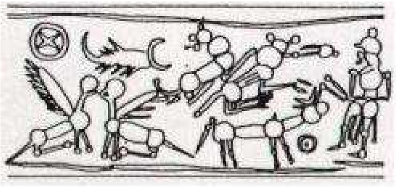
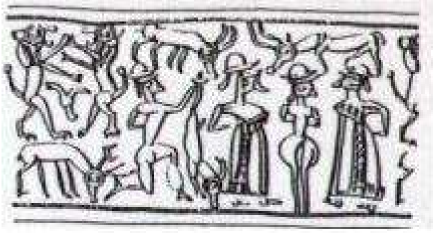
of the Sarasvati Sindhu Civilization. This opaque material, which was easy to cut and could be fired and glazed, made it possible to mass-produce seals.

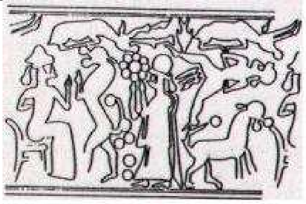
Cylinder seal impression: Nuzi (Drawn by D. Stein);



Alalakh (Collon, 1982). Hunting scenes with the motifs scattered freely in the field.

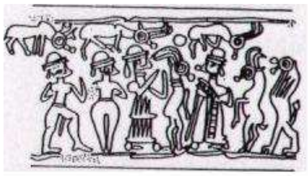


BM 89315; haematite; Frankfort, 1939, Pl. XXXIa. This is an Old Babylonian seal depicting the king with a mace between two suppliant godesses, to which Mitannian figures have been added, together with a two-register scene based on Syrian iconography (Collon, 1987, Fig. 268).

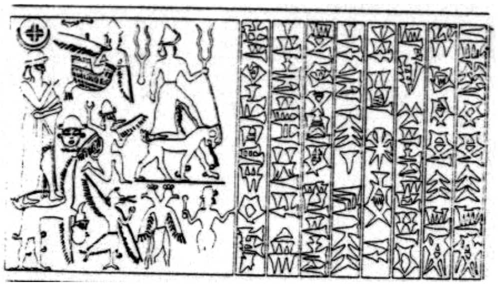


Cylinder seal impression: Ugarit (Schaeffer-Forrer 1983)--contest, hunting scenes.

Alalakh (Collon 1982)--a register of animals in a row above a row of worshippers; two antelopes in opposition, a standing lion.



Nuzi--person seated on a throne in front of a standing lion, a row of animals on top register, antelope? (Drawn by D. Stein).



Cylinder seal impression of Ithi-tes's'up son of Kipi-tes's'up; Nuzi Iraq. Impression on property decree. Legend: Ithi-Teshub son of Kip-Teshub king of Arrapha (Kirkuk) rolls out this seal on (a tablet concerning) a legal decision about fields and houses. For evermore let no-one break (the tablet). 5.1 cm.; (D. Stein; Collon, 1987, Fig. 269). The second seal of Ithi-Tes's'up displays many demons and deities which typify the late court style at Nuzi.

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Divided here on two levels, the demonic figures composed of lion, fish, bird, scorpion, snake and hina elements, have been interpreted as creatures of the netherworld (Porada 1979). The design is comparable to the design on Saushtatar's seal. Nuzi lay in the territory of Arappha.

A similar design appears on the seal found near Khorsabad (Dur Sharrukin), Iraq. BM 89819 (Badger Coll. 1853); pink and white jasper; Wiseman, 1959, Pl. 51; Collon, 1987, Fig. 270.

"Although hurlili constitutes a linguistic definition, and is basically a self-descriptive term, that corresponded to one in the Mitanni letter itself (hurwohe, hurrohe 'Hurrian'), several scholars went along with Ungnad's suggestion and called the language 'Subarian' after the place name Subartu found in Babylonian (Ungnad 1915, 1923, 1936: 133ff.). Since the language is already attested in proper names in the Ur III period (Hommel 1913) and earlier (Thureau-Dangin 1912), but the name Hurrian itself only since the Old Hittite period, Ungnad wanted to keep the word 'Hurrian' for the 'Subarian' of the Bogazkoy texts, even though he himself discovered that there was no essential difference between 'Hurrian' in this sense and 'Subarian' of the Mitanni letter...The excavations in Hattus'a, Mari, Ugarit, and Emar yielded new Hurrian texts...and the roster of Hurrian proper names rose into the thousands as a result of material uncovered in Nuzi, Kurruhanni, Alalakh, Ugarit, and many other places...One particularly extreme position was adopted by Ungnad (1936), who considered them to be the oldest ethnic substratum of Mesopotamia and of prime importance in post-neolithic culture..A new approach to the subject was postulated by I.J.Gelb, who proposed a clear-cut distinction between Hurrians and Subarians. In his view, the latter had been the linguistic and ethnic substratum of northern Mesopotamia since earliest times, while the former were merely late arrivals, a view shared by Speiser... (Gelb 1944)...Undue importance has long been attached to the historical significance, still controversial today, of the groups speaking Indo-Aryan, the origin of a whole range of names and appellatives which appear from the 15th century BCEonwards in texts from the Hurrian Mitanni kingdom and its political and cultural spheres of influence. Investigations into this specialist area within Hurrian studies have been charted by M. Mayrhofer (1966, 1974) in the form of an analytical Bibliography... the question of a possible prehistoric migration, perhaps from the other side of the Caspian Sea (Kammenhuber 1977, 1978: 214), must remain a matter for speculation until new sources come to light...Hurrians may be presumed to have been in the Near East from early times on the basis of the old Sumerian craft-word ta/ibira, 'copper worker', for which convincing proof of a Hurrian source can be adduced (Otten 1984, Wilhelm 1988). Atal-s'en describes himself as the son of one S'atar-mat, otherwise unknown, whose name is also Hurrian. The rule of Atal-s'en cannot be dated with certainty, but probably belongs to the end of the Gutian period (ca. 2090-2048 BC), or into the first decades of the Ur III period (2047-1940 BC)...Records from the Ur III period reveal that the mountain areas to tbe east and north of Tigris and Euphrates valley were at this time occupied by Hurrian-speaking peoples, who had meanwhile also penetrated the eastern Tigris country to the north of the Diya_la...As a result of S'ulgi's (2029-1982) wars, large numbers of Hurrian prisoners found themselves in Sumer, where they were employed as a labour force. This why so many people with Hurrian names can be traced in Southern Mesopotamia in the Ur III period...the etymology of some names is certainly or most probably Indo-Aryan, for example Artatama = Vedic r.ta-dha_man 'whose abode is R.ta', Tus'ratta (Tuis'eratta) = Vedic tves.a-ratha 'whose chariot surges forward violently', Sattiwaza = Old Indo-Aryan *sa_ti-va_ja 'acquiring booty', Vedic va_ja-sa_ti 'acquisition of booty' (Mayrhofer 1974: 23-25)...since the Hurrian language was in use in the 14th century BCEat least as far away as Central Syria (Qatna, also probably Qadesh), and since this expansion probably results from the population shifts during the rise of Mittani, it is not a priori impossible that

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Indo-Aryans also made their way to this part of the country...Among the gods who were still being honoured in the late 14th century by the kings of Mittani, we find Mitra-, Varun.a-, Indra-, and the Na_satya-twins, who are known to us from the Vedas, the oldest Indian poems. However, in as much as they are only attested so far in two versions of a state treaty (Laroche 1971 Nos. 51 and 52), the worship of these deities may have been restricted to dynastic circles. The inherited names of the kings of Mittani make it clear that the Indo-Aryan speaking groups played a role in the changing scene in North Mesopotamia in the 16th and 17th centuries which was not unconnected with an accomplishment suggested by the sparse remains of the Indo-Aryan language itself: various terms for horses, current in Nuzi in the early 14th century BC, were certainly or probably of Indo-Aryan origin (Mayrhofer 1966: 17ff., 1974: 29f.; also Kammenhuber 1968: 211ff.), and a Hittite tract on training horses (Kammenhuber 1961) derives from a Mittani expert in this field and contains Indo-Aryan technical terms, and from these two facts we may deduce that the Indo-Aryans were experienced in the breeding and training of horses. A combination of this equestrian skill and the use of the two-wheeled chariot engendered a military expertise which without doubt contributed much to the expansion of the Mittani kingdom...The two-wheeled chariot itself is now generally considered to have developed in the Near East and not, as once thought, to have been imported by the Indo-Aryans...In Mittani as well as in Syria and Palestine chariot-drivers were called marijanni-na, a term that has often, though not uncontroversially, been linked with the Old Indian marya 'yong man' (in Avestan also 'member of a group of men' (Mayrhofer 1966: 19, 1974: 16, Kammenhuber 1968: 222f., Diakonoff 1971: 76, Laroche 1980: 168)... (Gernot Wilhelm, *1989*, *The Hurrians*, trans. by Jennifer Barnes, Warminster, Aris and Phillips Ltd.).

"...on the other side of the Fertile Crescent. Here, from the beginning of the historical record to the middle of the second millennium BCE, it was the Hurrians who penetrated the agricultural regions of the lowlands--through long periods of time peacefully and as individuals, but occasionally en masse and in a warlike manner. The earliest written sources providing information about the political and linguistic situation in northern and eastern Assyria as well as in western upper Mesopotamia reveal that Hurrian minor states already existed in these districts about 2200 BCE. We cannot say when Hurrians first arrived in this area. Linguistic criteria, however, seem to indicate that the ancestors of the historical Hurrians had already inhabited the mountainous regions of eastern Anatolia for several centuries... The Sumerians probably borrowed their word for 'coppersmith' (TABIRA, TIBIRA) from proto-Hurrian [Hurrian *tab-li* 'copper founder'; *tab-iri* 'the one who has cast (copper)']...

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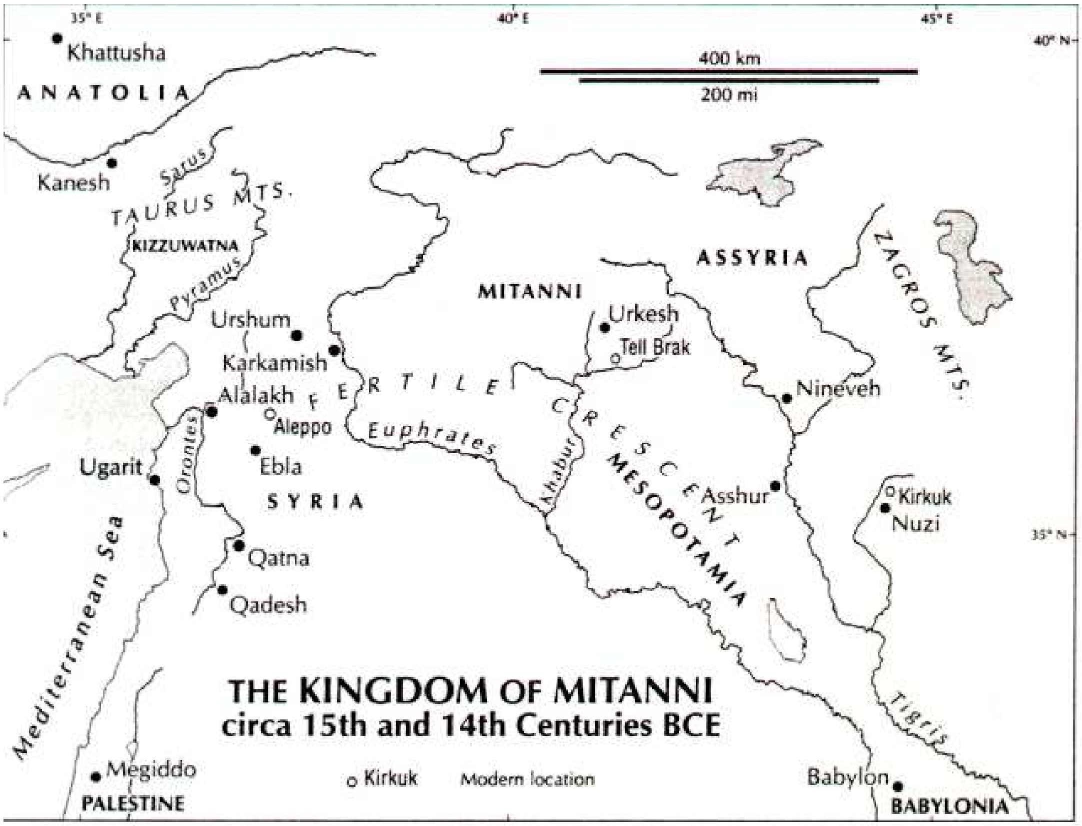

Map of the kingdom of Mitanni, ca. 14-15th cent. BCE

"...letters and documents of the Old Assyrian trading colonies of the twentieth and nineteenth centuries...

reveal that although practically no Hurrians lived in Kanesh (modern Kultepe), the center of trading activity, Hurrian names were common south of the Anti-Taurus Mountains in this period. We do not know when Hurrians migrated into the area between the Euphrates and the Mediterranean. The Ebla tablets of the twenty-fourth and twenty-third centuries give no indication of Hurrians in this region...

"...The Egyptian tomb biography of Amenemhet, an official who claimed to have invented a device for measuring time, refers to events of the final decades of the sixteenth century and includes the earliest mention of the name of this trans-Euphratean Hurrian state: Mitanni. This designation originates from the personal name Maitta, which is often attested in texts from Nuzi (modern Yorghun Tepe)...The names of the kings of Mitanni are known to us only from the early fifteenth century and later. Not one of these names is Hurrian. Rather, they are all derived with more or less certain etymologies from an archaic form of Indo-Aryan...In addition, a number of gods known from ancient Indian religious texts, such as Mitra (Mithras), Varuna, and the divine pair of the Nasatya, were worhipped at the court of the Mitannian dynasty. Finally, a number of words of Indo-Aryan origin are found in texts having some relation to Mitanni, most importantly terms associated with horse breeding, as well as the designation for the Mitannian chariot driver (*mariyanni*)... As the dynasty of Mitanni maintained the tradition of Indo-Aryan throne names into the thirteenth century, we may assume that the dynasty itself was of Indo-Aryan origin... the language spoken in Mitanni remained Hurrian...

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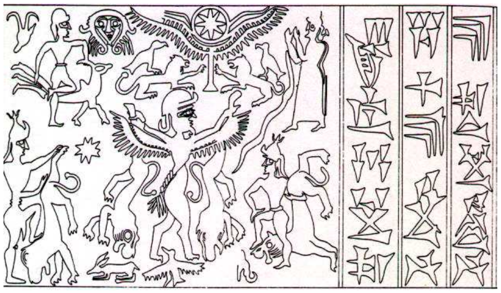
"...At present the earliest known direct evidence for a Mitannian ruler is the seal of a King Shuttarna, son of Kirta. Impressions of his seal are found on two records from the second half of the fifteenth century produced by a later king, namely, Saushtatar...



Drawing of the seal impression of King Saushtatar, Mitanni; from a tablet found at Nuzi; now in the museum at An Nasiriyah, Iraq (drawing by Diana Stein-Wunscher). The seal also gives the name of Saushtatar's father: Parsatatar. Legend on the impression: **Saushtatar, son of Parsatatar, King of Maittani.** The seal draws upon the glyptic heritage of northern Mesopotamai, where the repertoire of Early Dynastic and Akkadian themes was revived by multifarious winged monsters and demons. Created at the height of the Mitannian kingdom, this seal survived several generations as a dynastic seal used by Artas'umara and Tus'ratta at Tell Bra_k (Finkel 1985; Oates 1987) and by an unknown king at Nuzi (Stein 1989). The seal impressions on tablets have been found at Nuzi, Iraq and Brak, Syria. Porada, 1979, Fig. 2. Period Vb.

"The seal of Shuttarna I still stands fully in the tradition of Mesopotamian glyptic...The rule of Parrattarna I is to be dated to the first half of the fifteenth century...Already in the late sixteenth and early fifteenth centuries the expansion of Egypt under the first kings of the Eighteenth Dynasty had led to a confrontation with Mitanni. After the reign of Queen Hatshepsut, who interrupted this military expansion, Thutmose (Tuthmosis) III continued his grandfather's tradition and through far-ranging campaigns attempted to subjugate much of Syria to Egyptian rule...

"...The son and successor of Artatama, Shuttarna II, sent another Mitannian royal daughter to Egypt, where Amenhotep (Amenophis) III now rules...About 1365, Amenhotep was forced to break off diplomatic relations with Mitanni after the murder of its king. Following Shuttarna II, his son Artashumara became king, but after what was probably only a short reign--recently documented by a record from Tell Brak issued in his name--he was murdered and replaced by a younger brother Tushratta, who was still a minor...The most important source for the history of Mitanni from the reign of Artatama I on is constituted by the letters that Tushratta later--after his assumption of full rule--sent to the pharaohs. In these letters, which were discovered at Tell al-Amarna (Akhetaten) in Middle Egypt, he often refers to past events...He mentions as his initial military success a victory over the Hittites...Amenhotep accepted Tushratta's offer of the resumption of friendly relations. On his side, hearing of an illness of the pharaoh, Tushratta sent him the statue of the famous godess Shawushka of Nineveh, as his father Shuttarna had already done before him...

"...A Hittite army was sent to reconquer Mitanni, where Kili-Teshub henceforth bore the Indo-Aryan throne name Shattiwaza (formerly also read as Mattiwaza or Kurtiwaza). Since a copy of the Hittite-Mitannian treaty was deposited before 'Teshub, lord of the KURINNU of Kakhat,' this city, which probably is to be identified with Tell Barri (near the center of the Khabur triangle), must have belonged to the area controlled by Shattiwaza...Hittite influence over Mitanni was not of long duration. Shuppiluliuma died a few years later; his successor, Arnuwanda II, survived him for only about a year; and the next king, Murshili II, was still a youth and lacked the prestige of an experienced warrior...

"...Shattiwaza's country was no longer called Mitanni, but rather Khanigalbat...we learn that a king of Khanigalbat by the name of Shattuara I, probably the successor of Shattiwaza, owed tribute to Assyria...A change took place when the son of Shattuara, named Wasashatta (the

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inversion of Shattiwaza), in vain sought the support of Khatti against Assyria..."

(Gernot Wilhelm, 1995, The Kingdom of Mitanni in Second-Millennium Upper Mesopotamia, in:Jack M. Sasson (ed.), *Civilizations of the Ancient Near East*, Vol. II, pp. 1243-1254).

"Chariot models in clay as well as pictorial representations and full-sized chariots in burials show that wheeled vehicles had begun to make an appearance, but probably only for ceremonies, for their design suffers from severe shortcomings. Two main types are known: the four-wheeled 'battle-car', conveying a spear-thrower, and the two-wheeled chariot, which may have been developed for the hunt. Since horses seem to be unknown in Mesopotamia until the end of the third millennium, some other kinds of equid – perhaps onagers – acted as draft animals. The vehicles were very heavy; their wheels were of solid timber, perhaps banded with tires of rawhide, metal or wood. The axles were probably fixed to the wheels and so rotated with them. The draft pole was straight, and fixed very low down at the front. Such vehicles cannot have been swift or maneuverable; they appear to belong always to men of very high status. Indeed, it may in marking status that their importance lies, rather than as a practical asset in war. When they eventually developed into efficient battle chariots, they never lost that early association with superlative status. This is largely because a man had to be very wealthy to own and maintain a chariot and a team of horses. (Horses seem to have appeared in Mesopotamia around the end of the third millennium.)…

"The Amarna and Middle Babylonian Periods…Late Bronze Age in the second half of the second millennium…Battle chariots regularly had two wheels, mostly with four spokes (although six, eight, and nine are also known), and were drawn by a pair of horses, with one or two more running beside them as outriggers. A chariot-owning aristocracy arose, known as **mariyannu/martianni** which is thought to come from a word of Indic origin. Aryan involvement is confirmed by a horse-training manual found in the Hittite capital Bogazkoy (ancient Khattusha), in which many technical terms are given in an Aryan language related to Sanskrit…The time and expense involved in training and equipping for the chariot-owning aristocracy was such that soldiering became a more professional, hereditary occupation which affected activity all year round even though campaigns remained seasonal…Charioteers wore body armor consisting of copper or bronze platelets which overlapped and were attached to leather garments, the whole weighing up to fifty-seven pounds (about twenty-six kilograms). Sets of such armor were issued from the palace treasury, **bi_t nakkamti**, by the official in charge, **s'a_kin bi_ti**. Helmets were sometimes plumed and coverred in scales; one set of body armor, according to an administrative text, required 400 large copper scales for the coreselet, 280 small scales for the sleeves, and 190 scales for the helmet. The king was accompanied by a bodyguard known as 'men at the king's feet', s'u_t s'e_pe_ s'arri, consisting of ten chariots each containing the driver and an archer, with quivers containing upto fifty arrows attached to the side of the chariot car…Specialist craftsmen, including carpenters and bronzeworkers, were counted among palace staff. The Nuzi texts indicate that the economy of palaces was largely devoted to military supply with a professional organization that was capable of moving very large armies over long distances." (pp. 414-417).

[Setphanie Dalley, Ancient Mesopotamian Military Organization, in Jack M. Sasson (ed.), *Civilizations of the Ancient Near East*, pp. 413-422].

"The earliest weapons found in the Near East are microlithic projectile points from the Mesolithic period, some, at least, of which were used as arrowheads…Fortifications, which may be taken as evidence for the practice of warfare, appeared as early as about 4300 BCE at Mersin, in Cilicia, where a solid wall with projecting

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sections and simple interval towers was integrated into a ring of houses constructed on the wall's interior face. The system featured a simple straight gate passage, flanked by towers. By 3000 BCE, the city of Uruk in southern Mesopotamia was surrounded by a fortification wall about 9.5 km (6 mi.) long, built, according to the Epic of Gilgamesh, by Gilgamesh himself…By 3000 BCE the cities of Egypt were fortified with massive, solid walls strengthened by equally massive solid interval towers, sometimes rectilinear and sometimes semicircular…In about 2000 BCE, the most important …events were the collapse of the empire of the third dynasty of Ur (c. 2000 BCE) and the reunification of Egypt by Mentuhotep II (c. 1900 BCE)…In about 1600 BCE the first dynasty of Babylon was brought to an end by conquest by the Hittite king Mus'ili I, and in about 1550 BCE Ahmose I, first king of the eighteenth dynasty of Egypt, expelled the Syro-Palestinian dynasts…

"In Mesopotamia, the period beginning in about 2200 BCE saw the introduction of a revolutionary new weapon, the composite bow, which is first seen in the hands of NaramSin, King of Agade. His armies, like those of his grandfather, Sargon the Great, reached as far as the Mediterranean Sea.Yigael Yadin suggests that this weapon, with its unprecedented range and power, was a major factor in these conquests. (Yigael Yadin, 1963, *The art of warfare in biblical lands in the light of archaeological study*, London)…

"Middle Bronze Age II.. The crescentic battle-axe became heavier and generally had a socket for the haft. The advent of bronze body armour and helmets led to developments in the battle-axe, which became elongated and slender. Ultimately, it was reduced to a heavy armour-piercing spike, rather than the cutting edge it had been in the Early Bronze period. The wide-spread use of bronze also led to the development of the first swords, which were sickle shaped, with the cutting edge on the outside of the curved portion of the blade…The daggers of this period were distinctive, having a broad, veined blade attached to the hilt by rivets in a short tang. These daggers frequently had a crescentic pommel, often of stone. The type originated in Mesopotamia in the Early Bronze Age and in the Middle Bronze Age spread throughout the Near East and into Europe. Javelins and socketed thrusting spears were also in widespread use, as were slings, known primarily through artistic depictions.

"Although the compound bow had long been in use in Mesopotamia, surviving bows from Middle Kingdom Egypt, like the artistic depictions of bows, are all of the simple self-bow type, although some of them are slightly double-convex.

"At some point, probably late in Middle Bronze Age IIC/Middle Bronze Age III, a weapon was introduced into the Levant which was to change the shape of warfare in the ancient Near East and become the most important tactical factor until the end of the Bronze Age. This formidable weapon was the horse-drawn, two-wheeled chariot. Lightweight and highly maneuverable, the chariot served both as an assault weapon to break up infantry formations and as a mobile firing platform. As the infantry had no answer to the onslaught of chariots, particularly when they were used en masse, they quickly came to dominate warfare. In the form in which they were introduced into the Near East they came from the steppes of Central Asia. The manual used for training horses throughout the region then is known for its Indo-European technical terms, including the equivalent of the mediaeval knight: the **maryanu** warrior or charioteer." [Rupert Chapman, Weapons and Warfare, in: Eric M. Meyers, ed., 1997, *The Oxford Encyclopaedia of archaeology in the near east*, Oxford University Press, pp. 334-339).]

IE wagon, 'ratha', as a dwelling; ignorance of the use of bricks and mortar for houses

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"Chapter IX. Dwellings. Wagon-Dwellings -- Terminology of Wagon-Building-- Underground Habitats -- Indo-Germanic Huts -- Their Materials -- Their oldest Form -- Door -- Window -- Hearth -- Stalls...The ancients knewe that a great portion of the north of Europe was occupied by a semi-nomad population, whose only dwellings were their wagons, on which they conveyed their goods and chattels, wives and children, to fresh settlements and pastures new. This is stated most unanimously, with regard to the east of Europe, about the Scyths and Sarmatae, whose wagon-life is one of their most important characteristgics: 'Campestres melius Scythae, quorum plaustra vagas rite trahunt domos, vivunt et rigidi Getae.' (Hor., c. iii.24).

"But the same custom is to be found amongst peoples undoubtedly Indo-Germanic. Thus, the Bastarnae, the first Teutonic tribe to make its appearance in history (about BCE 200), carry their wives and children on wagons with them (Mullenhoff, *D.A.*, ii. 104, f.)...The dwellings of the Cimbri, which likewise were on their wagons ('domus plaustris impositae'), were defended by the dogs when their owners fell (Pliny, *Hist. Nat.*, viii.40.61), etc. (The most frequent term for the travelling wagon of the north is the Lat. *currus*, probably itself a barbarous word...Cf. O.I. carr, OHG charro, also καραμα ...In war these *carri* were used as a defence, *carrago*.)...

"After what we have said above (ch. v) about the unsettled mode of life amongst the other Indo-Europeans, and about the weakness of the ties that bound them to the soil on which they settled, there can be no doubt that the use of wagons as dwellings is a trait from the life of the primeval period which the northern tribes preserved. Nor can we wonder if we find a tolerably extensive terminology for wagon-building in the original language. To say nothing of the fact that nearly all Indo-European languages plainly use the root *ve^gh* to designate the wagon (Sanskrit va_hana, G. οχημα OHG. wagan, OS vozu, Lith. wezimas, OI fen (*veg-n), we find agreement in the names of the following portions of the wagon:

Wheel: Lat. rota, Lith. ra~tas, OHG rad, OI roth, Sans. ratha ('wagon')

Wheel: Sans. cakra, G. κνκλοαζ AS hweol (*qw-qlo'J)-- without reduplication: OS kolo, ON hve~l

Axle: Skt.. aksha, G. αεων Lat. axis, OHG ahsa, OS osi, Lith. aszis.

Nave: Skt. na_bhi, AS nafu, OHG naba, OPr. nabis.

Linch-Pin: Sans. a_n.i, OHG lun, AS lynes, O.Sax. lunisa, (Fick, *B.B.*, vii.95).

Pole: Lat. te^mo^ (*teicsmo^), OHG di^hsala, ON pisl, AS thi^xl (?).

Yoke: Skt. yuga, G. ξνγον Lat. iugum, Goth. juk, OS igo, Lith. jungas, Cymr. iou.

"**In this collection, it will be observed, there is no equation for the spoke of the wheel (Sans. ara_, G. κνγμγ Lat. radius, OHG speihha). The terms for felloe also diverge, except G. ιτνυζ which correspond exactly to Lat. vitus (lit. 'withy'). Perhaps OHG felga, 'felloe' belongs to OHG felawa, 'withy' (above, p. 271).**

"This indicates that we must conceive the primitive wheel as being without spokes. In the oldest times the only way known of making a pair of wheels was to hew them and the axle-tree connecting them all in a piece out of one and the same tree-trunk: and it must therefore be regarded as an advance when -- obviously before the dispersion -- the art of manufacturing the axle-tree separately, and of fastening it into the tympanum by means of a linch-pin, was discovered. (emphasis added).

"The picture we thus get corresponds to the description given by the ancients of the Roman plaustrum: 'The wheels of the plaustrum have not spokes, but are tympana which are of a piece with the axle-tree, and are surrounded by

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a rim of iron. The axle-tree turns round with the wheels; for the wheels are fastened by the spindles, i.e., the most projecting part of the wheel' (Probus on Virg., *Georg.*, i.). The Teutonic wagon drawn by cattle, which is represented on the triumphal column of Marcus Aurelius, must have been exactly the same (cf., e.g., Felix Dahn, *Urgeschichte der germ. und roman. Volker*, ii. 161).

"The acquaintance of the Indo-Europeans from of old with the art of wagon-building may be regarded as a distinctive characteristic of this family of peoples, which marks them off alike from the neighbouring Finns and the tribes of Turko-Tataric origin. Everything in the Finn languages relating to the art of wagon-building is of Slavonic or Teutonic origin (Ahlqvist, *Kulturwurter*, p. 125). So, too, according to Vambery (*Premitive Kultur*, p. 128), the wagon has been a foreign invention to the Turks of all times. From primeval times the inhabitants of the Asiatic steppes have employed the camel instead to carry on its patient back, tent, wife, and child. The Indo-Europeans however, who, as we saw on p. 267, did not enjoy the acquaintance of this valuable beast of burden, which is wagon and horses all in one, were at an early time driven to invent the wagon, a *sine qua non* of their wandering mode of life...

"...what their habitations were like...Here we have first to speak of the subterranean dwellings, i.e., dwellings dug in the earth, the existence of which is recorded amongst numerous Indo-Germanic peoples, and which afforded protection alike against the summer's heat and the winter's cold. Such habitations were still known in the Avesta under the name of kata* (: kan, 'dig') (Perhaps OS kasta, 'house, hut, tent', from *kont-ja, also beings here. It may be remarked that the Finn name for house is exactly the same as in Iranian: Finn kota, Esth. koda, Mordv. kud, Tscherem. kuda. Is this a case of borrowing?...Anyhow, the Finn. sauna, Esth. sawn, etc., 'subterranean dwelling', is genuinely Finn.). This word may be the source of the usual term for house in modern Persian (kad, kadah) and in the Pamir dialects (ked, ced, etc.); cf. Tomaschek, *Pamir D.*, ii. 77...

"The old Teutonic name for this kind of ssubterranean dwellings and weaving-rooms was OHG tunc; and to this day tung is the name given in Nurnberg, dung in Augsburg, to a cellar-like weaving-room. Now, as Tacitus expressly speaks of these dwellings being covered by fimus, nothing seems more obvious than to regard tunc, 'textrina', as identical with OHG tunga, 'stercoratio', 'manuring' (Wackernagel, *Haupts Z.*, vii.128, ff.). Only, on closer examination, it seems extremely suspicious that the Teutons should designate a kind of dwelling by a word which originally meant simply 'excreta' -- manuring was probably not known as early as Tacitus (Rautenberg, *Progr.*, p. 15, f., Hamburg, 1880).-- and not byh a derivate from the word.It seems to me, therefore, more reasonable to separate, as Graff (Sprachschatz) wished to separate, the two Old High German words, tunga, 'dun:ging', and tun, 'dwelling dug in the earth'. The latter can be referred to an Indo-Germanic dhn:gh. With this we could then connect the hiterto unexplained stock of words, G. ταφ–ροξ, 'trench'...in a perfectly regular manner as regards both phonetics and meaning...OHG tunc would then be equivalent to gruobe, with which it is occasionally synonymous (Wackernagel, loc. cit., p. 131)...

"It is, however, beyond the possibilities of doubt that they (Indo-Europeans) were already acquainted with the beginnings of the art of building huts and houses. This is directly indicated by such equations as: Sans. dama, armen. tun, Lat. domus, OS domu~, OI aur-dam, 'prodomus'; Goth. timrjan, 'joinjer'...Sans. s'a_la_, Lat. cella, Teut. halla (: cela^re, OHG helan); Zend. dvarem, 'door', Armen. durn, Lat. fores (also forum), OS dviri, 'door' (dvoru = forum), Lith. durys, Goth. daur, OI dorus (Sans. dva_r- (?)...

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"According to the statement of Tacitus (*Germ.* 16), the Teutons were ignorant of the use of bricks and mortar...Herodian says (vii.2) of Maximinus: 'He burnt down (anno 234) the whole district (of the Alemanni, Chatti, Hermunduri)...fopr the fire readily consumed whole dwellings, as owing to the absence of stone and bricks they are made entirely of wood,' etc. (cf. Baumstark, *Ausf. Erl.*, i. 566). Basket-work, too, was employed, as linguistic evidence indicates. Thus, in Old High German, want, 'wall', stands by the side of Goth. vandus, 'withy', in Gothic itself the wall is called vaddjus (ON veggr), which, coming from *voj-u-s, may belong to the root vei (*vej-eti) mentioned in the previous chapter on p. 329, with the original meaning in this case of 'plait'...

"What indirectly proves that stone buildings were unknown to the Teutons is the fact that nearly all terms relating to this new art are derived from the Latin. A reference to the collections in W. Franz (*Lat. -rom. Elemente im Althochd.*, Strassburg, 1884), will here suffice. Cf. OHG mu^ra = mu^rus, ziegel = tegula (The Goths had a native word, skalja...)...pfost = postis, phi^lari = pilarius, turri = turris, scintala = scandula, pforzih = porticus, charch = calx, etc...

"The state of things among the Slavs is similar. That the Veneti built houses even in the first century BC, in contrast to the Sarmatae, *in plaustro equoque viventibus*, is stated by Tacitus (*Germ*. c. 46). What miserable affairs these houses continued to be even centuries later is shown by what Procopis says (*B.G.*, iii.14)...Here too, language shows that we are only to think of wooden structures, for 'there is no pan-Slav expression to warrant the assumption that the primitive Slavs understood the art of building with stone' (Krek, *Einleitung*, p. 145)...

"It is very remarkable that a term for the house as a whole (OS hyzu), which recurs in all Slavonic languages, was borrowed, and that at an early date, from Teutonic (OHG hu^s, etc., of uncertain origin). OS hlevu, 'stall, hlevina, 'house', are probably of similar origin (O.Sax. hleo, ON hle, Goth. hlija)...

"In view of the undoubted dependence of the Greeks on the orientals for the art of building, it is a characteric feature in their linguistic attitude towards the intrusions of foreign culture (cf. above, pp. 74,146), that they confine themselves almost entirely to the resources of their own language in providing for the terminology of building...The linguistic attitude of the Romans towards Greek culture differed from that of the Greeks towards Semitic civilisation; and a very considerable number of Greek termini, belonging to a more advanced stage in the art of building, were taken over by Latin in the course of time (O. Weise, loc.cit., p. 193, ff.).

"Finally, the Indo-Iranians of the oldest period were also quite ignorant of stone buildings. In the epoch of the Atharvaveda the Indian houise was a purely wooden structure, which is described by Zimmer (*Altind. Leben*, p. 153) as follows: 'Pillars -- four in number-- were erected in the solid ground, and stays were placed obliquely against them. The corner pillars and foundation pillars were fastened together by roof beams. On them wer eplaced long bamboo rods, to act as spars for the lofty roof. Between the corner pillars various posts, according to the size of the house, were also erected. Straw or reeds were used in bundles to fill the insterstices in the walls, and to a certain extent to line the whole. Nails, clamps, cords, and straps served to hold the whole together.'

"A very similar appearance may have been presented by the house of the Avesta, about which, however, we know but very little (cf. W. Geiger, *Ostiran. Cultur*, p. 216); though the ancient Persians already knew how to burn bricks (Zend ishtya).

"How lightly built and tent-like, at any rate, the house of the Avesta people was is shown by a passage of the Vendidad to which Geiger (*loc.*

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cit.) refers, where in the case of a man.who has died from home two alternatives are mentioned as possible: either to take the corps to the dwelling or the dwelling to the corpse...

"Precautions must have been takenn at an early period to confine the fire to a certain place in the hut. Perhaps we may place here the -- certainly doubtful -- equation: Goth. auhns, OHG ofan = Sans. ukha~, 'vessel'. Cf., further Goth. azgo, 'ashes...just as Sans. a^sa, 'ashes' (Sans. a^sht.ri^, 'fireplace') = Lat. a~ra, Umbr. asa (OHG essa)...How foreign the notion of a regularly heated room was originally to the whole north is shown by the circumstance that the expression for the idea, though its origin is not yet ascertained, was taken over by the Teutonic (OHG stuba, Romance (It. stufa, and Lithu-Slavonic (Lith. stuba, OS istu~ba) languages alike...

[Dr. O. Schrader, 1890, *Prehistoric Antiquities of the Aryan Peoples: a manual of comparative philology and the earliest culture being the 'Sprachvergleichung und urgeschichte of Dr. O. Schrader'* translated by Frank Byron Jevons, London, Charles Griffin and Company, Exeter Street, Strand, pp. 338 to 354].

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Sarasvati Civilization

An overview

A historical project in search of River Sarasvati to discover our roots, has become a magnificent opportunity for national resurgence and to make Bharat a developed nation.

This is presented in three sections: observations, conclusions and areas for further research.

Observations

Many sparks have emerged from the anvils of scholars and researches of a variety of disciplines – all focused on the roots of civilization of Bharat.

Collated together, these sparks have become a floodlight which throws new light on the civilization of Bharat.

It is a new light on the civilization because of the following reasons:

- A mighty river, a river mightier than Brahmaputra had drained in North-west Bharat for thousands of years prior to 1500 BCE (Before Common Era).

- The collective memory of a billion people, carried through traditions built up, generation after generation, recalls a river called Sarasvati; this memory is enshrined in the celebration of a Mahakumbha Mela celebrated every 12 years at a place called Prayag where the River Ganga joins with River Yamuna. River Sarasvati is also shown as a small monsoon-fed stream in the topo-maps of Survey of India and in village revenue records in Punjab and Haryana.

> Yet, the tradition holds that there is a triven.i san:gamma (confluence of three rivers). The third river is River Sarasvati. This tradition has now been established as a scientific fact – ground truth -- thanks to the researches carried out using satellite imageries, geo-morphological studies, glaciological and seismic studies and even the use of tritium analysis (of traces of tritium present in the bodies of water found in the middle of the Marusthali desert) by atomic scientists. The desiccation of the river was caused by plate tectonics and river migrations, between 2500 and 1500 BCE.
>
> These studies have established beyond any doubt that River Sarasvati was a mighty river because it was a confluence of rivers emanating from Himalayan glaciers; the River Sutlej and River Yamna were anchorage, tributary rivers of River Sarasvati. The river had drained over a distance of over 1,600 kms. from Manasarovar glacier (W. Tibet) to Somnath (Gujarat) with an average width of 6-8 kms. At Shatrana (south of Patiala), satellite image shows a 20 km. wide palaeo-channel (ancient

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course), at the confluence of five streams – Sutlej, Yamuna, Markanda, Aruna, Somb – referred to as Pan~ca Pra_ci_ Sarasvati in Bharatiya tradition. This becomes Saptatha Dha_ra Sarasvati when two other streams – Dr.s.advati and Ghaggar – join the River Sarasvati at Sirsa

- A civilization was nurtured on the banks of this River Sarasvati as recognized through the work of archaeologists and the geographical/historical facts contained in ancient texts of Bharat, such as the *Mahabharata* and *Pura_n.a*. This civilization was an indigenous evolution from earlier than 10000 BCE and can be said to be one of the oldest civilizations in the world, heralding the Vedic heritage.

Over 2,000 archaeological sites have been discovered in the Sarasvati River Basin. There is a description, in 200 s'lokas, in the S'alya Parva of Mahabharata of a pilgrimage undertaken by Balarama, elder brother of Kr.s.n.a, along the River Sarasvati from Dwaraka to Yamunotri.

- The oldest extant human document is the R.gveda which is a compilation of 11,000 r.ca-s perceived by hundreds of seers. An understanding of this document is fundamental to an understanding of the cultural ethos of Bharat.
- R.gveda presents a world-view in allegorical and metaphorical terms perceiving an essential unity in cosmic phenomena and r.ta (a rhythm which modulates the terrestrial and celestial events alike). While the document presents the early philosophical thought related to *dharma*, it also describes the lives and activities of people – the Bharatiya. R.gveda thus presents a variegated picture covering a variety of facets of a maritime-riverine civilization, such as transport systems, agriculture, use of fire, minerals and metals to produce household utensils, ornaments, tools and weapons. Archaeologists have unearthed many examples of technology used in the days of the Sarasvati Civilization (from circa 3500 BCE to 1500 BCE). These provide evidence for the evolution of s'ankha industry in 6500 BCE, preparation of alloys such as pan~caloha, bronze, brass, pewter and bell-metal.
- A dialectical continuum has existed in Bharat from the days of R.gveda and Sarasvati Civilization. The civilization constituted a linguistic area, as it is even today in Bharat. Mleccha was a language spoken by Vidura and Yudhis.t.hira as evidenced by *Mahabharata*. Mleccha were vra_tya-s who worked with minerals and metals. The semantic structures (words and meanings) of all languages of Bharat – Munda, Dravidian or Indo-Aryan categories – present an essential unity among the speakers of various dialects of Bharat. The seven volume work on Sarasvati substantially draws upon the *Indian Lexicon*, which is a comparative dictionary of over 25 ancient languages of Bharat.
- Using this lexical repertoire of the linguistic area called Bharat, it has been possible to crack the code of the epigraphs of the civilization inscribed on over 4,000 objects including seals, tablets, weapons and copper plates. The epigraphs are composed of hieroglyphs (referred to as Mlecchita Vikalpa – picture writing --, one of the 64 arts listed by Va_tsya_yana).

The code of hieroglyphs is based on rebus (use of similar sounding words and depicted through pictures) and represent the property possessions of braziers – possessions such as furnaces, minerals, metals, tools and weapons. These were also traded over an extensive area upto Tigris-Euphrates river valley in Mesopotamia and the Caspian Sea in Europe.

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- The tradition of epigraphy evidenced in punch-marked coins and copper plate inscriptions in the context of Sarasvati Epigraphs points to millions of manuscripts and documents remaining unexplored all over Bharat.
- Ongoing projects for the rebirth of River Sarasvati has opened a new vista in water management in Bharat, which has an ancient tradition of water management exemplified by the rock-cut reservoir in Dholavira, the grand anicut on Kaveri, the step wells and pus.karin.is in all parts of Bharat.
- Desiccation of River Sarasvati is a warning to us about the unpredictability of the impact of tectonics on hydrological systems sourced from the Himalayas, for e.g. the Rivers Ganga and Brahmaputra.

Conclusions

- River Sarasvati is neither a legend, nor a myth, but ground-truth, a river which was flowing for thousands of years prior to Vedic times.
- Bharatiya Civilization is an indigenous evolution and cultural continuity is established from the Vedic times to the present day.
- For thousands of years before the days of Mahabharata War (ca. 3000 BCE), the Bharatiya had contacts with neighbouring civilizations.
- The historicity of *Mahabharata* has been established making it a sheet anchoe of Bharatiya Itiha_sa.
- After the desiccation of River Sarasvati (finally by about 3000 years ago), Bharatiya-s moved to other parts of the world.
- The metaphor of Samudra manthanam (celebrated in the *Bha_vata Pura_n.a*) is a depiction of the reality of a cooperating society which had united all the people of Bharat into life-activities including the environmentally sustainable use of natural resource offered by Mother Earth (Bhu_devi).
- Sarasvati is adored in Bharatiya tradition as a river, as a mother and as a divinity – *ambitame, nadi_tame, devitame sarasvati.* This is an abiding spiritual foundation which resides in the heart of every Bharatiya.
- The epigraphs evidence one of the early writing systems of the world.
- The search and discovery of River Sarasvati has revealed a thread of essential unity – a bond among the people of Bharat. This has emerged from Vedic times and continues even today. This is the unity of an integral society, a resurgent nation and a unified culture which can be found in all parts of Bharat, from the Himalayas to the Indian Ocean.
- Research Institutions have to be established in different disciplines of historical studies to study the manuscripts and documents in the archival collections in all parts of the country.
- The initiation of a project for interlinking of rivers is a laudable, first step in creating a National Water Grid which has the potential to ensure equitable distribution of water resources to all parts of the country and to make Bharat a developed nation in 15 years' time.

The establishment of the Water Grid is a national imperative and should be an unmotivated action (*l'acte gratuite*) devoid of political overtones.

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- The establishment of an inter-disciplinary Sarasvati Research Centre in Kurukshetra will help in progressing further researches on water resources management, and study of our history, heritage and culture.

Areas for further researches

- Glaciological researches are needed in relation to the glacial source of River Sarasvati which is referred to as *Plaks.a Pras'ravan.a* in the ancient texts.
- Seismological studies are needed to determine the chronology of events connected with the submergence of Dwaraka, the Gulf of Khambat and other coastal regions of Bharat.
- Meteorological, glaciological and seismological studies have to be related to plate tectonics – the dynamic Indian plate and the evolving Himalayas – for a better understanding of the hydrological systems, sustainability and management of a National Water Grid for Bharat.
- Archaeological work on the 2,000 sites on Sarasvati River Basin have to be related to the events described in the ancient epics: *Ramayana* and *Mahabharata*
- The Vedic texts, epics and Purana-s contain historical information.which can be validated through archaeological, astronomical and geographical studies.
- Epigraphical and language studies in relation to the evolution and spread of languages and scripts of Bharat.
- Scholars have to be encouraged to study the unexplored manuscripts lying in museums, libraries and private collections.
- Researches for establishing the National Water Grid should be objective and provide a new vision to reach out the water and agricultural resources of the country, equitably, to all people and for the development of the nation.

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Index

agriculture, 110, 266
Akkadian, 52, 83, 85, 86, 87, 110, 113, 114, 118, 120, 121, 210, 243, 246, 250, 252, 253, 258
Allahdino, 20
Amri, 20
antelope, 34, 40, 81, 149, 213, 230, 252, 254
Anu, 28, 143
Arabia, 73, 111, 250
Arabian Gulf, 11
Aravalli, 41, 57, 77, 79, 82
Archaeological Survey of India, 47, 53, 236
archaeo-metallurgy, 10, 141
archer, 143, 144, 225, 259
architecture, 132
armies, 142, 227, 259, 260
arrow, 22, 23, 26, 31, 33, 34, 35, 36, 37, 43, 46, 133, 139, 141, 142, 143, 145, 146, 147, 214, 220, 225, 227, 229, 245
arrowhead, 20, 37, 42, 64, 90
arsenic, 16, 19, 20, 22, 23, 31, 39, 47, 60, 73, 75, 83, 98, 115, 116, 118, 121, 125, 130, 237
Atharva Veda, 77, 135
Avestan, 6, 26, 243, 248, 256
axe, 16, 20, 22, 23, 27, 28, 29, 31, 33, 35, 36, 38, 39, 40, 41, 42, 43, 44, 45, 46, 52, 53, 54, 55, 88, 93, 97, 107, 108, 109, 110, 128, 136, 144, 149, 208, 210, 211, 212, 213, 215, 216, 217, 220, 226, 227, 232, 241, 242, 260
Bactria, 19, 90, 93, 130
Badakhshan, 85, 209
Bahrain, 88, 89, 90
Balakot, 20, 40
Baluchistan, 20, 22, 24, 27, 39, 40, 69, 80, 109, 118, 120, 215, 247
Banawali, 20, 36, 38, 42, 46, 47, 107, 132, 155
barbed spear, 27
barley, 37, 74, 100, 104, 247
barter, 77
bead, 20, 23, 36, 39, 61, 74, 102, 108, 111, 114, 115, 139
beads, 16, 20, 33, 36, 40, 42, 48, 60, 61, 64, 66, 101, 102, 108, 109, 112, 116, 120, 139, 197, 209, 214, 215, 253
bed, 84, 114
belt, 39, 78, 81, 83, 195, 213, 216, 226
Bha_rata, 8, 9, 10, 11, 18, 25, 37, 57, 80, 93, 95, 97, 125, 132, 139, 270
Bhr.gu, 147
Bitumen, 215
blade, 20, 22, 23, 26, 27, 28, 31, 33, 34, 35, 36, 37, 38, 40, 41, 42, 44, 47, 48, 49, 50, 51, 53, 63, 64, 76, 93, 95, 98, 110, 113, 115, 116, 117, 122, 128, 133, 144, 191, 206, 207, 208, 210, 211, 212, 213, 214, 215, 216, 217, 218, 225, 226, 228, 230, 260
BMAC, 130
boar, 221, 235
boat, 86, 107, 112, 225
bone, 4, 36, 133, 154, 216, 235
bow, 46, 102, 106, 133, 141, 142, 143, 144, 145, 146, 147, 210, 214, 217, 220, 222, 225, 226, 227, 228, 230, 232, 245, 260
bow and arrows, 217, 232
brahman, 142
brass, 14, 56, 57, 58, 65, 74, 81, 102, 130, 224, 229, 266
brazier, 1, 100, 102, 110, 136
brick, 24, 36, 45, 60, 62, 99, 100, 101, 104, 121, 151, 215, 230
bronze, 14, 16, 17, 18, 19, 20, 22, 23, 24, 26, 27, 28, 29, 30, 31, 33, 35, 36, 37,

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38, 39, 40, 41, 42, 43, 44, 46, 47, 48, 49, 50, 51, 53, 54, 55, 56, 57, 60, 63, 64, 66, 71, 72, 73, 74, 76, 79, 80, 81, 83, 84, 85, 86, 87, 88, 90, 93, 94, 108, 109, 110, 113, 114, 115, 116, 118, 119, 120, 121, 122, 125, 128, 129, 130, 132, 157, 160, 161, 163, 164, 165, 167, 169, 170, 171, 172, 173, 174, 175, 176, 177, 178, 179, 180, 181, 183, 184, 185, 186, 187, 188, 189, 190, 191, 192, 193, 194, 208, 210, 212, 216, 232, 236, 237, 241, 242, 246, 247, 252, 259, 260, 266
Buddha, 48, 135, 239
buffalo, 35, 98, 102, 133
buildings, 14, 48, 132, 263
bull, 15, 37, 64, 89, 91, 110, 111, 130, 134, 136, 140, 146, 149, 236, 251
bun, 73, 85, 88, 98, 110, 121, 214
burial, 20, 240, 241
camel, 243, 262
caper, 61
caravan, 84, 104, 114
carnelian, 16, 19, 40, 48, 61, 66, 74, 101, 114, 116
cart, 104, 106, 107, 128, 201, 215, 236, 237, 241, 242, 243, 247
cattle, 107, 141, 219, 239, 262
cemetery, 29, 63, 212, 232
Central Asia, 28, 69, 81, 90, 91, 130, 131, 208, 232, 242, 260
ceramic, 39, 59, 62
Chalcolithic, 16, 38, 39, 84, 89, 112
Chanhudaro, 27, 33, 47, 54, 107, 121, 126, 237
chert, 26, 27, 49, 101, 215
chisel, 16, 20, 22, 23, 29, 33, 34, 35, 36, 39, 42, 54, 65, 88, 213, 214, 216
Cholistan, 20, 22, 43, 64, 125, 130
circular brick, 104
citadel, 26, 53, 62, 104
cities, 58, 65, 75, 86, 107, 111, 214, 215, 220, 230, 245, 260
city, 44, 65, 74, 84, 86, 114, 120, 123, 214, 219, 220, 235, 252, 258, 260
clay, 17, 23, 26, 27, 40, 45, 53, 54, 56, 57, 64, 66, 74, 87, 102, 104, 134, 210, 215, 216, 241, 259
cloak, 216
cloth, 1, 29, 76, 228, 229
clothing, 61, 195
cobra, 236
coins, 14, 46, 77, 125, 267
conflict, 142, 144, 251, 253
cooking pot, 60
copper, 1, 14, 15, 16, 19, 20, 22, 23, 26, 27, 28, 29, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 70, 71, 72, 73, 74, 75, 76, 77, 79, 80, 81, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 96, 98, 100, 101, 102, 105, 107, 108, 110, 112, 113, 114, 115, 116, 118, 119, 120, 121, 122, 123, 124, 125, 128, 129, 130, 132, 141, 156, 159, 162, 168, 206, 207, 209, 210, 212, 213, 214, 215, 216, 217, 218, 219, 229, 237, 238, 246, 255, 256, 259, 266, 267, 270
cotton, 54, 215
cremation, 39, 145, 215
crocodile, 225
crucible, 20, 25, 36, 39, 57, 74, 76, 100
cubical, 36, 101
cuneiform, 85, 87, 120, 121, 243, 250
cylinder seal, 19, 52, 86, 89, 110, 146, 247, 251
dagger, 20, 22, 23, 35, 37, 40, 44, 47, 49, 50, 63, 64, 93, 95, 113, 133, 139, 206, 207, 208, 213, 216, 226, 232
deciphering, 85
deer, 112, 202, 230, 231
deity, 52, 108, 215, 226
dharma, 266

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Dholavira, 14, 20, 26, 34, 37, 63, 132, 236, 241, 267
Dilmun, 72, 73, 86, 88, 90
dog, 64, 89, 236
donkey, 84, 105, 243
dotted circle, 126, 133, 202
Dr.s.advati, 151, 265
Dravidian, 6, 242, 266
drill, 16, 20, 31, 35, 36, 66, 88
drilling, 66
Durga, 132, 133
dye, 99
Early Harappan, 20, 101, 102
Egypt, 27, 36, 45, 47, 50, 53, 72, 73, 74, 75, 76, 84, 111, 112, 113, 123, 207, 212, 213, 233, 234, 235, 243, 258, 260
Elam, 49, 76, 85, 113, 114, 235
elephant, 37, 98, 109, 139, 140, 223, 225, 227, 228, 237
engraver, 64
etched, 116, 214
faience, 42, 66, 253
farm, 245
figurine, 20, 37, 60, 90, 246
fillet, 76, 152
fish, 20, 23, 33, 36, 38, 41, 42, 43, 54, 64, 91, 101, 107, 136, 215, 255
Ganga, 53, 57, 92, 93, 94, 95, 96, 122, 238, 265, 267
Ganweriwala, 43
gateway, 136
gazelle, 146
Ghaggar, 57, 265
glass, 53, 83, 120
goat, 34, 89, 230, 231
godess, 8, 28, 133, 214, 250, 258
gold, 15, 16, 20, 23, 40, 43, 56, 60, 61, 62, 65, 69, 73, 74, 75, 76, 77, 80, 84, 85, 86, 91, 108, 109, 112, 113, 114, 117, 119, 123, 124, 125, 130, 138, 152, 169, 195, 208, 209, 212, 214, 216, 221, 222, 224, 225, 226, 229, 235
goldsmith, 16, 17, 112, 123, 215
granary, 99, 104
Gujarat, 11, 16, 36, 37, 70, 80, 81, 82, 93, 95, 101, 114, 121, 125, 241, 247, 265
Gulf of Khambat, 11, 125, 268
gypsum, 100
hammer, 22, 23, 26, 35, 43, 60, 65, 100, 207, 210, 227
Harappa, 1, 20, 22, 23, 29, 31, 33, 34, 35, 37, 39, 42, 46, 47, 48, 52, 53, 58, 59, 60, 61, 62, 63, 65, 66, 70, 81, 93, 95, 98, 99, 101, 102, 104, 106, 108, 109, 111, 113, 121, 127, 141, 191, 192, 193, 195, 202, 213, 214, 215, 218, 219, 230, 231, 236, 237, 248
hare, 64
headdress, 76
hearth, 51, 74, 75, 98, 118
Himalaya, 270
Hindu, 10, 30, 70, 80, 91, 132, 133, 148, 220, 226, 228
hoard, 36, 37, 40, 41, 42, 49, 53, 58, 59, 60, 91, 92, 93, 94, 98, 195, 211, 218, 236, 238, 246
horned, 15, 89, 102, 136, 140, 146
horse, 28, 37, 105, 106, 135, 208, 213, 222, 223, 227, 230, 232, 235, 236, 239, 241, 242, 243, 244, 245, 247, 257, 259, 260
incised, 25, 67, 76, 81, 100, 116, 132, 133, 138, 191, 230, 236
Indo-Aryan, 5, 87, 96, 244, 248, 249, 251, 255, 257, 258, 266
Indo-Iranian, 250, 263
ingot, 23, 33, 43, 72, 91, 98, 114, 246
inlaid, 16, 27, 131, 212, 224, 226
inscription, 6, 27, 45, 56, 71, 128, 140, 191, 241, 246, 252, 253
ivory, 27, 35, 54, 66, 87, 106, 109, 133, 154, 224
Jarrige, 39, 63, 66, 70, 231, 248
jasper, 66, 255

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jewelry, 84, 213
Jhukar, 27, 29
Kalibangan, 20, 37, 38, 41, 42, 43, 47, 54, 65, 99, 104, 108, 130, 132, 236, 247
Kalyanaraman, 1, 2, 3, 8, 9, 10, 12, 117
Kannad.a, 5
Kashmir, 11, 37, 270
Kenoyer, 1, 31, 40, 56, 59, 60, 66, 70, 195, 201, 247
Khetri, 23, 38, 57, 72, 80, 83, 122
kiln, 1, 16, 23, 36, 59, 60, 64, 215
Kish, 24, 73, 76, 84, 111, 112, 211, 212, 214, 216, 233, 242
kohl, 23
Kon
kan.i, 5
Kot Diji, 20, 27, 38, 40, 66
Kunal, 20, 132
Kutch, 11, 36, 64, 125, 247
Lal, 20, 41, 42, 43, 52, 53, 64, 65, 80, 81, 92, 93, 94, 95, 96, 98, 107, 108, 122, 123, 155, 156, 236, 238, 248
language, 4, 5, 8, 10, 26, 119, 242, 243, 245, 251, 255, 257, 259, 261, 263, 266, 268
languages, 3, 5, 6, 9, 10, 96, 119, 120, 248, 250, 261, 262, 263, 264, 266, 268
lapidary, 62, 102
lapis lazuli, 16, 19, 67, 70, 81, 84, 86, 110, 120, 209, 216
lead, 1, 16, 20, 23, 24, 31, 40, 43, 56, 57, 58, 59, 60, 74, 75, 76, 80, 85, 86, 90, 113, 114, 115, 117, 123, 124, 125, 130, 208, 230
Lothal, 20, 35, 38, 41, 47, 49, 55, 57, 64, 65, 70, 72, 88, 97, 98, 121, 168, 241, 247
Mackay, 17, 20, 22, 24, 32, 33, 35, 40, 46, 47, 48, 49, 50, 51, 54, 60, 70, 80, 93, 98, 107, 108, 126, 127, 128, 129, 141, 210, 211, 212, 214, 218, 219, 236, 237, 247
Magan, 48, 72, 87, 90, 111, 120
Maha_bha_rata, 132
Mahadevan, 126
Makran, 48, 67
Marshall, 23, 34, 47, 51, 53, 54, 60, 69, 70, 80, 81, 107, 134, 136, 146, 218, 219
Meadow, 66
Mehrgarh, 20, 39, 66, 70, 231
Meluhha, 13, 14, 19, 72, 73, 74, 80, 81, 86, 88, 89, 120, 121, 213, 242
merchants, 14, 75, 84, 85, 86, 111
Mesolithic, 20, 259
Mesopotamia, 11, 14, 19, 27, 36, 43, 44, 45, 48, 60, 70, 71, 72, 76, 81, 84, 85, 87, 88, 90, 105, 106, 107, 112, 114, 121, 122, 123, 132, 135, 213, 214, 215, 234, 235, 243, 244, 247, 251, 252, 255, 256, 259, 260, 266
metal, 1, 8, 14, 15, 16, 18, 19, 20, 23, 25, 26, 27, 28, 30, 31, 33, 35, 43, 51, 56, 58, 59, 64, 66, 69, 70, 72, 73, 74, 75, 76, 77, 79, 80, 83, 84, 85, 88, 89, 90, 91, 92, 98, 100, 101, 108, 109, 113, 114, 116, 117, 118, 119, 120, 121, 122, 123, 125, 130, 132, 150, 206, 207, 210, 213, 214, 215, 216, 218, 220, 227, 229, 233, 234, 238, 244, 245, 246, 259, 266, 270
metallurgy, 10, 16, 75, 81, 83, 84, 85, 89, 90, 112, 113, 115, 116, 118, 120, 121, 123, 124, 125, 130, 141, 207, 246
metals, 1, 14, 15, 16, 17, 26, 30, 43, 56, 64, 65, 69, 70, 72, 73, 74, 75, 76, 80, 84, 85, 86, 100, 111, 116, 119, 120, 125, 130, 215, 248, 266
mining, 57, 59, 72, 75, 83, 117, 270
Mleccha, 266
Mlecchita, 266

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Mohenjodaro, 20, 22, 23, 24, 27, 43, 47, 48, 54, 56, 58, 59, 80, 81, 98, 99, 102, 108, 110, 113, 121, 127, 209, 219, 236, 241, 242
molded, 60
mortar, 45, 99, 100, 215, 227, 260, 263
mould, 1, 24, 36, 41, 64, 88, 206, 212
mud-brick, 36, 230
Nausharo, 20, 60, 201, 231, 248
necklace, 23, 62, 114, 136, 138, 139, 140
Neolithic, 74, 77, 92, 93, 115, 242
onager, 105, 247
one-horned, 136, 140, 146
onyx, 225
ore, 22, 23, 24, 30, 51, 57, 59, 74, 75, 77, 80, 81, 82, 90, 98, 113, 114, 115, 116, 117, 118, 120, 121, 122, 238, 239, 270
organization, 10, 259
ornaments, 14, 16, 18, 23, 36, 37, 46, 60, 64, 80, 108, 109, 112, 116, 148, 167, 178, 195, 207, 266
ovens, 42
Oxus, 70, 81
painted pottery, 109
Pakistan, 29, 39, 41, 43, 58, 99, 101, 106, 218, 231, 236, 239, 248
Palaeolithic, 110
Parpola, 89
peacock, 118, 134
pendant, 20, 37, 133, 136, 138
perforated, 24, 26, 54, 216
Persian Gulf, 69, 87, 90, 91, 111, 121, 125, 214
pictographic, 215
pipal, 39, 215
Pirak, 231, 247
plants, 37
platform, 37, 62, 99, 100, 101, 102, 233, 236, 260
Pleiades, 226
Possehl, 36, 37, 42, 47
pottery, 23, 27, 38, 39, 49, 57, 59, 60, 65, 80, 81, 108, 109, 114, 122, 213, 216, 218, 231, 240, 241
Priest, 15, 16
Procession, 146
punch-marked, 14, 137, 267
Punjab, 11, 27, 36, 61, 91, 108, 125, 214, 248, 265
Punjabi, 48
quartz, 57, 117, 253
R.gveda, 2, 8, 10, 11, 14, 85, 132, 135, 139, 141, 143, 236, 266
Ra_ma_yan.a, 56, 226, 229
Rajasthan, 11, 17, 22, 31, 34, 37, 40, 41, 47, 57, 58, 59, 80, 81, 82, 83, 93, 94, 98, 108, 120, 121, 122, 123, 129
Rakhigarhi, 62, 63, 132
ram, 34, 91, 97, 220, 244
ratha, 14, 141, 169, 213, 221, 222, 232, 235, 236, 244, 251, 255, 260, 261
Ravi, 60, 66, 99, 242
raw material, 20, 66, 67, 72, 74, 85, 102, 129
rebus, 15, 16, 140, 266
red ochre, 48, 59
reservoir, 267
rhinoceros, 30, 98, 228
rice, 37, 231
Rings, 35
Rojdi, 36
Ropar, 20
Sanskrit, 3, 5, 6, 103, 114, 117, 119, 134, 140, 230, 232, 242, 243, 245, 248, 251, 259, 261
Santali, 15, 16, 101, 102, 103, 235
Sarasvati, 2, 3, 8, 9, 10, 11, 12, 13, 16, 19, 26, 38, 40, 41, 42, 43, 57, 62, 67, 70, 72, 74, 85, 92, 107, 108, 116, 125, 132, 135, 151, 206, 241, 249, 251, 254, 265, 266, 267, 268, 270
Saurashtra, 102

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saw, 16, 22, 23, 27, 35, 49, 64, 83, 87, 116, 123, 216, 231, 240, 260, 262
sealing, 116, 134, 140
serpent, 111, 149, 215
Shaffer, 86
Shahr-i-Sokhta, 74
sheep, 85, 112
shell, 35, 39, 40, 42, 44, 65, 66, 67, 109, 110, 112, 213, 216, 218, 229
ship, 48, 86, 114, 243
Shortughai, 80
Sickle, 35
Silver, 46, 63, 74, 77, 123, 162, 224
Sindh, 19, 61, 67, 72, 107, 108, 110, 116, 201, 214, 218, 222, 237
Sindhi, 5, 54
Siwalik, 48
snake, 227, 255
soma, 26, 104, 141
sorghum, 231
spear, 20, 27, 34, 43, 44, 45, 50, 51, 64, 88, 93, 134, 140, 214, 216, 217, 222, 225, 226, 227, 228, 232, 233, 244, 259
spearing, 91
spotted, 216, 230
steatite, 33, 40, 66, 77, 101, 131, 214
stoneware, 56, 108
stoneware bangle, 56
stool, 51, 253
storage jar, 60, 65, 102
Sumerian, 23, 43, 45, 72, 74, 75, 88, 90, 109, 112, 120, 207, 208, 212, 213, 214, 215, 216, 218, 236, 237, 242, 255
Susa, 24, 48, 53, 64, 73, 76, 84, 85, 90, 113, 114, 121, 211, 212, 213, 218, 233, 242
Sutlej, 265
Swat, 36
symbols, 14, 18, 132, 134, 137, 138, 139
tablets, 64, 75, 105, 113, 119, 152, 252, 253, 257, 258, 266
Tamil, 3, 5, 17, 103, 136, 137, 138, 147, 249, 251
Taxila, 46, 58, 133
Telugu, 3, 5
temple, 45, 72, 80, 140, 149, 150, 151, 252
Tepe Yahya, 39, 67, 113, 114, 115, 116
terracotta, 16, 20, 36, 51, 59, 64, 66, 101, 107, 132, 133, 139, 195, 236, 241, 247
terracotta cake, 64
throne, 242, 253, 254, 257, 258
tiger, 16, 140, 221, 228, 229
Tigris, 58, 89, 255, 266
tin, 16, 19, 20, 26, 28, 29, 38, 43, 51, 54, 56, 57, 60, 64, 70, 71, 72, 73, 74, 75, 76, 77, 78, 80, 81, 82, 83, 84, 85, 86, 87, 88, 91, 93, 98, 113, 114, 116, 117, 118, 120, 121, 125, 208, 215
tin bronze, 43, 81, 114
toilet, 23, 37, 109, 112, 218
tools, 14, 16, 18, 24, 26, 33, 34, 42, 43, 44, 45, 46, 47, 51, 54, 59, 63, 64, 66, 80, 81, 84, 88, 91, 93, 96, 97, 102, 112, 114, 116, 118, 122, 123, 126, 127, 128, 129, 157, 159, 160, 161, 170, 171, 172, 173, 174, 176, 178, 179, 183, 185, 187, 188, 190, 191, 193, 215, 231, 266
traders, 72, 90
transport, 75, 230, 237, 242, 243, 244, 266
tree, 48, 52, 76, 109, 119, 136, 215, 222, 233, 261
trefoil, 16, 109, 218
triven.i, 265
Turkmenistan, 40, 130
turquoise, 39, 131
United Arab Emirates, 88
Ur, 23, 27, 43, 44, 45, 73, 75, 76, 77, 84, 87, 88, 90, 104, 105, 110, 111, 112, 113, 206, 210, 211, 212, 213, 214, 216, 218, 233, 242, 253, 255, 260

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Vats, 22, 39, 47, 59, 70, 81, 100, 104, 218, 219
vedic, 17, 150
vessels, 16, 18, 23, 30, 33, 57, 59, 72, 81, 162, 163, 164, 208, 209, 213, 214, 215, 216, 218
votive, 91
war, 23, 26, 105, 132, 143, 145, 149, 210, 212, 221, 222, 226, 227, 228, 229, 232, 235, 240, 241, 243, 245, 251, 259, 261
warfare, 43, 141, 211, 212, 213, 226, 230, 234, 235, 259, 260
weapons, 13, 14, 16, 18, 23, 24, 26, 31, 33, 35, 46, 49, 51, 59, 60, 63, 72, 74, 77, 84, 88, 92, 93, 94, 95, 98, 112, 114, 118, 121, 126, 129, 132, 133, 136, 137, 138, 140, 141, 144, 147, 148, 149, 150, 151, 157, 167, 205, 211, 212, 215, 216, 217, 222, 225, 226, 227, 228, 229, 232, 233, 245, 246, 259, 266, 270
weaving, 231, 262
weights, 36, 88, 90, 101, 172, 215
wheat, 37, 100, 104, 231, 247
Wheeler, 27, 53, 99, 101, 120
workshop, 16, 36, 39, 40, 64, 90, 98, 100, 102, 103
workshops, 62, 65, 90, 98
worship, 239, 250, 256
writing, 8, 10, 12, 44, 83, 85, 136, 214, 215, 266, 267
writing system, 8, 10, 12, 267
yajn~a, 16, 29, 57
Yamuna, 38, 92, 95, 122, 238, 265, 270
Yudhis.t.hira, 229, 266

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End Notes

[1] **Cultural history of Himalaya: Metallurgical heritage of Badrinath**

Badrinath is a pilgrimage centre of Bha_rata. With the auspiciousness associated with metal weapons and the protective significance of weapons which adorn the s'ilpa of mu_rti in all temples of Bha_rata and in the sculptures which are seen all over Bha_rata, it is a reasonable hypothesis that Badrinath was also connected with the Bronze Age and metallurgical traditions of Bha_rata.

Indeed, it was. South of Badrinath was a band of ancient workings of copper mines.

Western Garhwal is the region where River Sarasvati_ originated from the Svarga_rohin.i mountain range (Bandarpunch massif, close to Rupin and Supin glaciers and the tributaries of Sarasvati_: Rivers Tons (Tamasa) and Giri), and north of Paonta Saheb in Himachal Pradesh. (Paonta Saheb now has a 10 km dia. lake as a relic of the spot where Yamuna captured the waters of River Sarasvati_ to join the Gan:ga at Prayag, after linking up with River Chambal -- Vais'ambhalya_, the nourisher of the vis').

"Jammu, Kashmir and Tibet. The areas which have major clusters of old workings are in the Banihal, Anantnag and Baramulla districts…In the Shomal area of Anantnag, the shafts are about 2m wide and 10 m deep while at Mamal, also in Anantnag, the hillside showed pits, generally 10m deep and 5m across. The old workings at Lashteal in Baramulla showed more complexity: the main shaft (1m wide) goes down for 3m, leveling off for about 5m to terminate in a room of about 10 cubic m. The shaft leading to it is about 2 m high. From the room-like space itself, a shaft (1m high) goes down steeply to come out of the side of the hill where the terrain is flatter and more accessible.

"Himachal Pradesh: Chalcopyrite and pyrite with some secondary chalcocite, malachite and azurite are spread along 13 km in the Shallu valley from Atoll to Batera in Simla district. The Chisani, Maol, Malanna, Kot Kandi, Chitrani, Shatgurh near Jerri and Kanor khad localities in Kulu showed copper, in addition to Narnaul and Danala where the mineralized zone extends for about 10 km in the Garsah valley, Uchih in the Parvati valley where pyrite and arsenopyrite occur at the **silver workings** and the Kulu Bijnar area where there are about 20 occurrences. In Sirmur, malachite stains were noted at Banal. Old workings with slag heaps have been noted in the Garsah valley, near Chisnai and in Sirmur (for the details, Raghunandan et al. 1981; Ball 1881).

"Uttar Pradesh: Kumaun-Garhwal: The occurrence of copper in the rgion including such high altitude districts as Chamoli and Pithoragarh have long been known. Ball (1881) is informative in this regard, but the old copper mines of Kumaon are also discussed in GW Traill's (1828) 'statistical sketch of Kumaun' and in an account of JD Herbert's 'on the mineral productions of that part of the Himalya mountains, lying between the Sutlaj and the Kali (Gagra) rivers' (JD Herbert, 1932, repr. 1980, On the mineral production of this part of the Himalaya mountains lying between the Satlaj and the Kali (Gagra) Rivers…, *Asiatic Researches*, 18, New Delhi,, 227-58). The most detailed early account is by FJ Stephens (1901-02: 393-414) whose description of the old workings and preindustrial mining methods underlines the scale and nature of copper extraction and ore processing in different parts of Kumaon. According to Stephens, there were two types of ore in the region: irregular deposits worked extensively at Dhanpur, Dobri and Al-Agur, and regular nodes distributed from near Pithoragarh to the area south of Badrinath and beyond Pokri. This 50 mile long band is the major copper-bearing zone of the region, with localities like Rai, Bellar and Barabesi in Kumaun and Gwaldrum and Pokri in Garhwal being located here. At Dhobri, Stephens noticed many old workings which ramified to an extraordinary extent. The Dhanpur hillside where the formations dipped with the slop of the hill and thus provided easier facilities for mining was burrowed with holes. Situated on the western bank of the Ramganga, the Al-Agur deposit where some old

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workings went down to grat depths contained carbonate of copper and grey copper ore with a little pyrite. The other deposits included Tarag-ke-tal (10 miles north of Dwarrahath) and Goron (3 miles west of Pithagora) where the lodes were not rich but the old miners honeycombed them 'with holes like a rabbit warren, and taking out every particle of copper (FJ Stephens, 1901-02, Geology and mineral resources of Kumaon Garhwal, *Transactions of the Institution of Mining and Metallurgy,* X: 405). At Rai, Stephens noticed that 'the ancient miners must have gone down to a considerable depth, as every drive has more or less encountered unsuspected and masked old workings…the whole surface at Rai is honeycombed with irregular burrows of every description. In one of these, the remains of a skeleton partly impregnated with copper carbonate was discovered' (Stephens 1901-2: 409-10)." [Chakrabarti and Lahiri, 1996, pp. 14-15].

Pre-Harappan cultures. Aq Kupruk. "In Afghanistan, at Aq Kupruk (Dupree 1972; Shaffer 1978) the remains of an epipalaeolithic (last stage of Palaeolithic cultures) culture go back to c. 15,000 BCE, followed by a Neolithic culture with the evidence of domestication of sheep and goat. These Neolithic levels, without pottery, have provided two uncorrected (5730-half-life based) radiocarbon dates, viz. 8565+-240 BCE and 6960+-105 BCE (approximately 10,000-8,000 BCE calibrated). The subsequent ceramic bearing levels are dated by four dates viz., 5806 BCE, 5638 BCE, 5292/5286/5241 BCE and 3307-3110 BCE (Possehl 1990: 3-4). Thus, the beginning of the ceramic Neolithic, hence of pyrotechnology, in South Asia goes back to the sixth millennium BCE.

"Mundigak…(Period I) the most frequent metal artefact of the entire Mundigak sequence was a simple type of bronze point or punch with a circular cross-section…Frequently encountered utilitarian objects in Periods III-IV were small curved knives or sickles and chisels, and only in Period IV, a few barbed hooks. Three important metal artifacts located in Period III were the only examples of socket-hole axes (two) and an adze…Mehrgarh…The lowest levels of Mehrgarh, in area MR-3, yield a Neolithic culture with stone and bone tools: polished axes, adzes and chisels…Period III may be placed in the first half of the fourth millennium BCE…In Period III, fragments of crucibles with traces of melted copper, and **bun-shaped copper ingots** were also found…Period IV (c. 2800 BCE)…**A chisel, a flat axe and a double-spiral headed pin were the copper artifacts, as also compartmented seals, both in terracotta and stone**…Period VIII (mid-third millennium BCE)…The typically Harappan designs of **pipal-leaf, fish-scale and intersecting circles** had begun to appear in Period VII. The terracotta humped bull reminds one of the Harappan counterparts. The designs on terracotta seals include the **swastika, cruciform motifs** and what looks like **running animals**…Period VIII (contemporary with the late Harppan)…Bronze objects including a **shaft-hole axe**…Nausharo…6 km. South of Mehrgarh…Period II (first quarter of 3rd millennium BCE)…some pots bear characteristic signs of the Indus script…all structures of Period ID had been 'heavily burnt and the walls turned red due to heat' (Jarrige 1989: 64)…Damb Sadat…copper objects inclusive of a dagger, alabaster vessels, a compartmental seal, clay and shell bangles, bone and ivory beads…Nal, Kulli and Nindovari…faunal motifs include ibex, gazelle, zcorpion, fish, birds and humped bull…Mehi…cremation burials, the bones lying generally in urns…Nindowari…two seals with typical characters in the Harappan script with the unicorn motif…Rehman Dheri…ivory seal, with two holes…engraved two mountain goats, along with three symbols (c. 3000 BCE)…Sarai Khola…a dozen copper/bronze objects comprising spearheads, needles, nail-parers, antimony rods with rolled ends, pins, rings and bangles (mid-3rd millennium BCE)…Kot Diji…a fragmentary bronze bangle…Kalibangan…an axe, a paras'u and a bangle of copper/bronze…Banawali…an arrow-head and a fish-hook of copper…a stone weight (87.855 gms.)…Kunal…variety of ornaments in gold and silver. These include spiral bangles, 'crowns' and discular bead with axial perforation – all of silver and over twelve thousand beads…seven seals, six of steate and one of shell. These seals do bear motifs, mostly geometric, but no inscription." [DP

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Agrawal, 2000, *Ancient metal technology and archaeology of south Asia: a pan-Asian perspective*, New Delhi, Aryan books international, pp.57-68].

[2] "Investigators in all periods have been faced with one major fact. Because southern Mesopotamia is virtually lacking in mineral resources, the materials used to make the metal artifacts found there must have come from another locale. Thus, our research led to the metallogenic zones in Iran, Afghanistan and Oman, where ores of copper, among others, are known to occur in substantial quantities...we have also uncovered significant new information on tin deposits which could have been exploited in antiquity...Other metals were also used for this purpose (alloying) by ancient metal workers, most notably arsenic, antimony and lead. Arsenic, in particular, played an important role in the early metallurgy of the Near East...The earliest occurrence of tin-bronze date to the 4th millennium.Though the total number of artifacts analyzed from this period is not large, those of tin-bronze are even fewer: three pins from Necropolis A at Susa (with tin contents of 4%, 8% and 2.3% respectively), and an awl from Sialk III (0.95%). In the later 4th and early 3rd millennia, greater tin values occur--5.3% in a pin from Susa B; and 5% in an axe from Mundigak III in Afghanistan; but these are still exceptional in a period characterized by the use of arsenical copper...arond 270 BC, during Early Dynastic III in Mesopotamia...eight metal artifacts of forty-eight in the celebrated 'vase a la cachette' of Susa D are bronzes; four of them -- three vases and one axe -- have over 7% tin. The analyses of objects from the Royal Cemetery at UR present an even clearer picture: of twenty-four artifacts in the Iraq Museum subjected to analysis, eight containing significant quantities of tin and five with over 8% tin can be considered true bronzes in the traditional sense...In addition, a contemporary shaft-hole axe from Kish contains 4% tin, and significant amounts were detected in a few artifacts from Tepe Giyan and Tepe Yahya IVB in Iran, and Hili in Oman. Thus, we see an increasing pattern of tin usage...We explored the area south of Herat, where several deposits of tin were said to exist. At Misgaran, tin appears 500 meters north of a copper mine which was worked in ancient times, although the precise dates of exploitation are not known. The copper ores here contain over 600 ppm (0.06) of tin. Tin-bearing sands, which can be easily beneficiated by panning, were worked in the nearby Sarkar Valley. There too the tin was found in association with copper, green traces of which are visible throughout the landscape...Gudea of Lagash (2150-2111BC) speaks of the tin of Meluhha...the geographer Strabo (XV.2.10) who, in referring to the inhabitants of Drangiana (modern Sistan), says that they have 'only scanty supplies of wine, but they have tin in their country'...this passage..does accord well with the discoveris in the area of Herat...There are two possible routes from Afghanistan to Mesopotamia. One crosses the northern part of the Iranian plateau, along the Elburz mountains, then through the passes in the Zagros descends to Babylonia and Assyria. In the 1st millennium it was one of the principal supply routes of eastern goods to Assyria. In the 2nd millennium the tin that Assur exported to Anatolia might have followed this route. Along it are found such sites as Tepe Sialk (where the use of tin is attested in the 4th millennium), Tepe Giyan and Tepe Hissar, wehre other finds (such as lapis lazuli at Hissar) implicate them in long-distance commerce in the 3rd millennium.

"The second route is by sea, along the Arabian coast of the Gulf, perhaps also going by land through souther n Iran. It was at the time of Gudea of Lagash and earlier in the Early Dynastic III period, the great supply route of eastern commodities to southern Mesopotamia. It is by this route that the copper of Makkan came, copper which analysis has shown to have originated in the peninsula of Oman. It also brought the products of Meluhha, including lapis lazuli, carnelian, copper, ivory and various woods. Nothing, however, suggests the passage of tin through this area. For example, there is little tin in the artifacts recovered at Qala'at al Bahrain, dating between 2300 and 1800 BCE. Furthermore, we know from the work of Limet, who studied texts concerned with metalworking in Sumer, that Mesopotamian metalworkers did their own alloying. We suspect, therefore, that the tin moved through this area in an unalloyed state.

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"Recently Oman has yielded the first signs of the use of tin in the region. The analysis of a sword from Hili, dated to the mid-3rd millennium, shows a tin content of 6.5%, and a mold of a tap hole (?) associated with the remains of a furnace held metal with a tin content of 5%. The furnace is dated after the tree-ring calibration of a radiocarbon analysis (MC 2261) to circa 2225 BCE...it is clear that the tin was added to the copper and it is also clear that it did not come from Oman itself. At Umm an-Nar artifacts with tin contents on the order of 2% were recovered; the tin must have been mixed with the local copper...Meluhha...the use of tin is attested already in the late 4th or early 3rd millennium at Mundigak III in southern Afghanistan. Tin appears only in small quantities in artifacts from Sahr-i-Sokhta in eastern Iran and at Tepe Yahya in southern Iran...In the Indus Valley, the copper-tin alloy is known at Mohenjodaro.

"...Oman's trade with southeastern Iran and Baluchistan is well attested...Among the products attributed to Meluhha, lapis lazuli and carnelian are found in sites and tombs of the 3rd millennium. We can suggest with reasonable certainty that the tin used in Oman was in transit through Meluhha and that the most likely source was western Afghanistan. The discoveries of tin in artifacts at Hili, though singular, are important because the site lies in an area clearly involved in long-distance trade. However, there is no clear evidence that the site was a way-station on the route which brought tin from Afghanistan to Mesopotamia. Therefore the presence of tin at Hili indicates only that it was transported in the Gulf area, where it was also used to fill local needs.

"The collective indications are that western Afghanistan ws the zone able to provide the tin used in Southwest Asia in the 4th and 3rd millennia...In order to elucidate the questions raised by our findings, a project aimed specifically at tin-- its sources and metallurgy--should be organized." (Serge Cleuziou and Thierry Berthoud, Early Tin in the Near East, in: *Expedition*, Vol. 25, No. 1, 1982, pp. 14-19).

"...the stages in metal technology in Iran can be studied in greater detail. Coghlan (Cog 51) has traced the complete sequence of metallurgical development in Sialk. In the beginning, Pds. I and II, copper tools were produced by simple cold hammering. Casting, first in open mounds, was evidenced in Pd III,4. Closed moulds came into use from Pd. III,5. In Pd IV smelting and casting techniques by cire perdue method are also met with. All these techniques are datable (Pd I, ca. 5000 BC; Pd IV, ca. 3000 BCE onwards) and are thus much earlier than in India...

"Tal-i-Iblis in Mashiz Valley (Kirman range) is the earliest known centre of copper metallurgy (ca 4000 BC)...Kerman range is very rich in copper ores. Bevelled rim bowls in Tal-i-Iblis of Mesopotamian vintage (ca. 2800 BC) may show long distance trade in ores or metal (CS 66). Lamberg Karlovsky (L 67) studied the pottery collected by Stein from Daruyi and Tappa-i-Nurabad, east of Tal-i-Iblis, in the valley of Baluk. He found its close similarities with the pottery of Chah Husseini (Bampur), and Rana Ghundai I and II. These may provide the evidence for contacts and diffusion from this centre to India too.

"One does not know exactly how these techniques reached Baluchistan, via Makran or Afghanistan...we will trace these influences from Mundigak with which there is evidence of plenty of contacts. The Phase C (D 65) witnessed the advent of metal in this area which we placed in ca. 3300-3000 BCE. From Deh Morasi II Z, Dupree (Dup 63) has reported hollow copper tubes which resemble those from Hissar II levels... Mundigak (Cas 61) in Afghanistan offers a complete sequence of metalurgical development. Copper appears in Pd I as evidenced by the presence of elbowed blades (lame coudee) and an awl (Pd I,5). In Pd II, appear spear-heads, internaly voluted spiral-headed pin and eyed needle. Such spearheads continue to Pd IV. Lamberg Karlovsky (L 67) called it a tanged dagger with midrib, though in the section given, there is no midrib (Cas 61, Fig. 139,3). In Pd III, tin-alloying also is reported (L 67). But the analyses (Table 23) show that Pd I has higher tin content (0.86 to 1.06%) than that of

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Pd III (0.6 to 0.77%). Pd III is relatively richer in copper. The tool repertoire includes shaftholed axe and adze (III), spearhead without midrib, a sickle blade (?). In Pd IV were found a pin with double voluted head, concave disc (IV) fish hook and other likebits, including a lance object with bent blade. In Pd V metal finds are not many, mostly they are arrow heads (Cas 61, Fig. 140, 26,25).

"In Baluchistan we hardly get any stratified metal relics. From Isplenji mound I (Pak 64) and Quetta some copper artifacts were recovered along with Quetta Ware. Few fragments of copper were found in Damb Sadaat II and III.

"In Phase D of Dales are mainly included the Pre-Harappan cultures of Sind, e.g., Kot Diji, Kalibangan and other sites in Bahawalpur region. From the pre-Harappan levels at Kot Diji only one copper object has been reported (Kh 65). At Amri only metal scraps appear along with a handmade pottery and Togau C sherds. Kalibangan I yielded only two-three pieces. The other sites only suggest some sort of use of copper. From Kulli we got a mirror, pin and flat axe. From Nundara only a bangle is reported.

"At Nal, a good number of metal tools were recovered from the cemetery and D, and F areas. The types include: knives; blades; bangles; axes etc.

"We have thus traced the diffusion from Iran, through Afthanistan and Baluchistan, to Sind. Thus we see that the metallurgical know-how is reaching the Harappans of Sind only about 2300 BC, more than 1500 years later than west Asia. During the Harappan period there is a sudden efflorescence of copper tools and their variety, as compared to the Pre-Harappan cultures. This obvious diffusionary route, the relatively late date of the Harappans and a full blown metallurgy from the very start preclude any independent origins of metallurgy in the Harappan culture." (D.P.Agrawal, *The Copper Bronze Age in India*, New Dehli, Munshiram Manoharlal, 1971).

[3] **INGOT: Some Indic Lexemes and Homonyms (used for logographs of the script) (Akkadian: le_'u)**

3833.To melt: li_ melt; lau absorption, devotion (H.); laya absorption (Skt.)(CDIAL 10962). ri_ melt, flow (Skt.); ri_yate_ melts, flows (RV.); ri_n.a melted (Skt.); riik to leak (of contents), drip; rieik to leak (of vessels), let drip (Kho.); rijan.u to water, to irrigate; to melt (S.); ri_n.a leaked, dripped (Pkt.); runna_ pret. of ren.ava_ (Si.)(CDIAL 10753). cf. re_n.i mud (Pkt.); ren.i_ ingot (L.)(CDIAL 10639). aliyuka to melt, dissolve (as salt, heart); alika, aliyikka to melt; aliccal, alivu melting, compassion; ali-ppun.n.u foul ulcer (Ma.); ali- (aliv-, alij-) to dissolve; (alip-, alic-) to dissolve (Kod..); aliyuni to dissolve, decay; eliyuni, e_luni to melt (as any soft substance, butter, lead etc.); elipuni, elpuni, e_la_vuni id. (Tu.)(DEDR 250). Image: to be delivered of a child: allna_ to become clear (of liquids left undisturbed)(Kur.); le to get clear (as water when left undisturbed)(Malt.); alga tidy, clear; alga a_va to be tidy, clear, be delivered of a child (Kui)(DEDR 261). Fluids: al.akam water (Ta.); al.aka, al.l.aka neither thick nor thin, as applied to fluids (Ka.); anuku semiliquid, semifluid (Te.)(DEDR 298). cf. al.acu to agitate (liquid)(Ka.)(DEDR 294).

5516.Image: flow, current: raya the stream of a river, current; speed, velocity (Ka.Skt.)(Ka.lex.) re_tas a flow, current (Vedic); ri_ti moving, flowing; motion, course; a stream, river (Skt.)(Skt.lex.) raya stream, current (MBh.); current, speed (Pali.Pkt.); rava speed (Pali); ra sediment left by river after inundation (S.); rau small stream from the mountains, course or flow of river (P.); current, stream, torrent, line (H.); rai long narrow channel made for flow of water from higher level (Or.)(CDIAL 10638). cf. re_n.i mud (Pkt.); ren.i_ ingot (L.); ingot of gold or silver (P.); ren. cement for metallic objects (G.); ravan.aka a filter (BHSkt.)(CDIAL 10639). ri_n. name of a deserted channel of the river Jhelam (L.)(CDIAL 10750). re_ve the Narmada_ river (Ka.lex.) ri_ti stream (RV.); ri_i path, fashion (Pkt.); ria shallow narrow channel for catching fish in dry season (Or.); ri_ method, manner (G.)(CDIAL 10751). reju, rejo irrigation, first

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watering before sowing (S.)(CDIAL 10820). ri_ti dropping, flowing; a course; ri_n.a dropping, trickling, oozing, distilling, flowing (Ka.lex.) http://www.hindunet.org/saraswati/Indian%20Lexicon/ore.htm

[4] "Tin procurement at Mari was highly organized (Dossin 1970; Villard 1984: nos. 555-6). It travelled in the form of ingots weighing about 5 kg. each. It reached Mari by donkey caravan from Susa (Susiana) and Anshan (Elam) through Eshnunna (Tell Asmar). The relevant records contain the names of Elamite rulers and Elamite agents (Heltzer 1989). Tin was transmitted westwards, both as an item of royal gift-exchange and as a trade commodity...it may well often have travelled by sea up the Gulf from distribution centres in the Indus Valley. In the Old Babylonian period tin was shipped through Dilmun (Leemans 1960: 35), as it had been a millennium earlier to judge by references in the Ebla texts...Strabo (xv.ii.10) referred specifically to Drangiana, the modern region of Seistan in south-west Iran (into Afghanistan) as a source of tin. Muhly (1973: 260) associated this directly with Gudea's report of receiving tin from Meluhha...A number of scholars have pointed out the possibility that tin arrived with gold and lapis lazuli in Sumer through the same trade network, linking Afghanistan with the head of the Gulf, both by land and sea (Stech and Piggott 1986: 41-4)." (PRS Moorey, 1994, pp. 298-299).

"Latin *stagnum-stannum* only comes to mean 'tin' in Late Latin. The word originally designates 'a mixture of lead and silver'. Again, it si not clear why the word came to mean 'tin'. The original Latin designation for tin is not a distinct word at all, but the expression *plumbum album,* sometimes *plumbum candidum,* literally 'white lead'...Pliny refers to a practice of plating objects with tin to give them the appearance of silver:

A method discovered in the Gallic provinces is to plate bronze articles with white lead as to make them almost indistinguishable from silver; articles thus treated are called 'inoctilia'.

Recent archaeological discoveries indicate that such deceptions were practiced not only on metal objects, but also in clay. Excavations at several Mycenaean sites have produced clay vessels with surviving incrustations representing an original tinfoil covering applied with beeswax...

The Greek word for tin, □□□□□□□□□□, is again of unknown origin....Some feel that the word is to be analyzed as *kassi-ti-ra*, 'from the land of the Kassites'. This derivation is of considerable interest in the light of the suggested connection of the Kassites with the Zagros mountains and the indications...that this area might have been an important source of tin. Yet this etymology is quite improbable and cannot be substantiated...there is no indication that the Greeks played any role in (Celtic) trade before the founding of the Massalia (modern Marseilles) around 600 BCE. Since the Greeks did not come into contact with the Celtic peoples of Gaul much before the end of the seventh century BC, it would be strange to find a Celtic word already in Homer...this factor...rules out a Celtic origin for *kassiteros*...there is no common Indo-European word for tin. Of course the various Romance languages have a common word borrowed from Latin, and the various Germanic languages (with the exception of Gothic) seem to have a common word which may ultimately derive from the same source. This is all the result of a late development. The fact that Latin uses an expression like *plumbum album* to mean 'tin', indicates that the language lacked a real word for the metal...In fact, the earliest Indo-European texts, such as the Mycenaean Linear B tablets and the earliest Sanskrit texts, seem to lack a word for tin. What of Hittite? Unfortunately, here the situation is once again problematic. A word has been suggested, namely **dankui-*. However, even if correct, it says nothing significant about the source of tin in the Hittite empire. The word is clearly a manufactured one, derived from the adjective *dankui*, 'dark', very common in Hittite texts, especially in reference to the dark earth...a lexical text from Ras Shamra seems to equate the Hittite **dankui-* with Sumerian An.NA, Akkadian *ana_ku,* both words now translated 'tin.' Also, if the reference is to the black tinstone of alluvial deposits, the name is quite appropriate.

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"The basic Hebrew word for tin is *bedi_l*. The principal reference is from the book of Ezekiel:

Tarshish traded with you because of your abundant wealth of every kind; she bartered with you silver, iron, tin, and lead.

This passage suggests that tin came to Israel from Tarshish, sometimes identified with the south coast of Iberia. The tin trade with Tarshish is thought to have been in the hands of the Phoenicians...this Hebrew word for tin has been compared with Sanskrit *pa_t.i_rah,* 'tin'...a late lexical word in Sanskrit, and seems to belong to that group of words which includes French *peautre,* Italian *peltro* and English *pewter.* These words all go back to an original **peltirum* or **peltrum,* often said to be of Ligurian origin...these words may all be based on the stem **pel-,* meaning 'gray, blackish'...the Old Testament has another word which may represent tin. *Ana_k* is traditionally translated 'plumb line' or 'plummet'. The most important reference is in the book of Amos:

Thus he showed me, and lo, the Lord was standing upon a wall, with a plumb line in his hand.

"...if Hebrew *ana_k* is to be compared with Akkadian *ana_ku,* then the *Homat. ana_k* should be 'a wall made of tin'. ..The Sumerian AN.NA is sometimes transcribed *nagga*, but there are objections to this reading and it is best to retain the reading AN.NA, in capitals. The meaning 'tin' is established by the fact that the cuneiform texts contain recipes involving the mixture of copper [Sum. *urudu,* Akk. *eru*) with AN.NA in order to produce what can only be bronze (Sum. *zabar,* Akk. *siparru*). The first of these texts dates from the pre-Sargonic period: *1 ma.na 1/3 urudu luh ha AN.NA bi gin 13 igi 3 gal* (That is, 80 shekels of pure copper and 13 1/3 shekels of tin are mixed together, producing a bronze with a copper-tin ratio of 6:1. The Sumerian texts from the Third Dynasty of Ur uses the expression *zabar-7-la,* indicating a bronze with a copper-tin ratio of 6:1. A ratio of 7:1 is also known from this period as the following text indicates: *5 gin AN.NA 1/2 ma.na 5 gin urudu luh-ha* (Here 5 shekels of tin are mixed with 35 shekels of copper giving a copper-tin ratio of 7:1). In the Old Babylonian period, the ratio is again 6:1: *3 ma.na zabar s'a 6 ba-al.lu* (three minas of bronze mixed (in the ratio) of six (to one)

"...Such a ratio means a bronze with about 17% tin...This connection between the texts mentioning the mixture of URUDU and AN.NA and the copper-tin ratio established through the analysis of ancient Mesopotamian bronzes is one of the most convincing arguments for the translation of AN.NA as 'tin'...A bilingual literary text refers to the fire-god: urudu AN.NA III.III bi za e-me-en *s'a e-ri i u a-na-ki mu-bal-lil-s'u-nu at-tạ*(you (fire) are the one who makes an alloy of copper and tin.)...The Akkadian word seems to have cognates in Hebrew *ana_k,* Arabic *a_nuk,* Syriac *a_neka_,* Ethiopic *na_'ek,* and perhaps even Armenian *anag*...already in the Old Akkadian period, there are references to ingots of tin called *s'uqlu* and weighing about 25 kg. The Old Babylonian letters from Mari refer to tin in a form designated by the word *le_'um.* This word, usually translated 'tablet,' is also used to designate the Neo-Assyrian hinged wax-covered ivory writing board foundat Nimrud in 1953. The Mari references must be to an ingot of tin shaped something like a tablet. The Cape Gelidonya ship-wreck has now produced a Late Bronze Age example of a tin ingot. The excavator of the wreck, G.F. Bass, says of this find:

At Gelidonya, therefore, we may have the shape of the end of a tin ingot which was six centimeters on a side; the length of the bar is unknown. Such a shape would correspond to the larger ingot which we have identified in the tomb of Nebamu_n and Ipuky...

"...In addition to these ingots there also tin, as well as copper, ingots from the site of Harappa. (C.C. Lamberg Karlovsky, *American Anthropologist*, 69 (1967) 145-162, p. 149).The existence of tin ingots is well atteste for all periods and all areas of the ancient world, from ca. 2000 BCE. to 400 AD. Such an ingot the Egyptians called a *nms'.t dh* and *dh* must then be the Egyptian word for tin...

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"The myth of Inanna and Mount Ebih also mentions 'the high mountain land, the mountain land of carnelian and of lapis lazuli' (kur.BAD-na kur-na gug-na za-gin-na) which is of interest as there seems to be, as will be shown below, some connection between the source of tin and the sources of carnelian and lapis lazuli...since one of the exemplars of this myth mentions Enheduanna, the daughter of Sargon of Akkad, it would seem that the work may go back to the Agade period.

"...The mountains of Lu_ristan are also the location of the land of Barahs'e, known from the Neo-Sumerian period as Marhas'i...One of the texts from al-Rimah does refer to fifty minas of tin from the Nairi-lands. The Nairi-lands are now fairly well known, especially as they appear in the inscriptions of Tukulti-Ninurta I and Tiglath-Pileser I. They occupy the area northwest of Assyria, the region of Diyarbakir and the lands to the east of it, with a population said to be related to the later Urartaeans. The 'sea of the Nairi-lands' (*tamdi s'a ma_t na-i-ri*) would then be identified with Lake Van...

"The reference to 'the Caphtorite' and the clear implication that tin was sent from Mari to Crete are bound to arouse heated controversy. It should come as no surprise here, as this study has repeatedly emphasized the eastern connections of Minoan metallurgy. Strange as it may seem to those rooted in the insularity of the Aegean world, we must now seriously consider the possibility that the tin used by Minoan metal-workers came to Crete from Mari. The 'itinerary' (published by G. Dossin) also implies that the representatives of Crete and Caria, together with a translator (Akkadian targamannum), received their tin at Ugarit...

"J. Bottero and M. Birot have assumed that the tin came from Iran and was brought to Mari by Elamites...The text TLC X 125 refers to 1 1/3 minas, 9 2/3 shekels of pure silver...This text may indicate that silver was brought to Larsa in order to purchase tin and that this tin was purchased in Susa. That is, Larsa did not purchase tin in the north. On the contrary, it supplied tin to the north...Old Assyrian and Old Babylonian period ca. 2000 BCE to 1600 BCE..The tin was sent from Sippar to Mari, and from there was re-exported to Syria and Palestine. The tin came to Sippar from Susa, either by way of De_r and Es'nunna or by way of Larsa, coming up from the south. The beginnign of the trade, the determination of the ultimate origin of the tin, still remains to be established...A text from the reign of Gudea of Lagash (ca. 2143-2124 BC) provides a possible clue in this direction. In his elaborate cylinder and statue inscriptions Gudea provides considerable information concerning the origin of the various materials used in his extensive building program. Gudea says that the tin he used came from the land of Meluhha:

(urud)u AN.NA lagab-za-gin na(k)u NE gug-gi rin me luh ha da (copper and tin, blocks of lapis lazuli...bright carnelian from (the land of) Meluhha)

"The land of Meluhha is well known as a source of lapis lazui and carnelian. This is the only direct reference to tin from Meluhha, but the Gudea passage suggests that tin may be associated with the Meluhha trade, a trade also involving copper, lapis lazuli and carnelian. Of all the items involved here, the one which is most securely localized is lapis lazulip. The lapis lazuli used in Mesopotamia came from northern Afghanistan, from the Sar-i-Sang mine in Badahshan. No one has ever proposed that Meluhha be identified with Afthanistan. The current tendency is to identify Meluhha with Sind and the coastal region of western Pakistan. This would mean that the expression 'lapis lazuli from Meluhha' refers not to the actual source of the material, but rather to the entrepot from which it was sent to Mesopotamia. Lapis lazuli from Meluhha would then be an expression parallel to copper from Tilmun.

"It is now assumed that the references to the land of Meluhha in texts relating to the latter part of the third and early part of the second millennium BCE are to be associated with the now established relations between Mesopotamia and the Harappn civilization of the Indus Valley during the Sargonic and Isin-Larsa periods. This was a sea-borne trade going down the Persian Gulf and across the Arabian Sea, such as existed in the

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Hellenistic, Roman, and Byzantine periods. The best known example of such a voyage is that undertaken by Nearchus, the admiral of Alexander the Great, in the year 325 BCE. Nearchus set out from the newly built harbor at Pattala, near the mouth of the Indus river, with 1800 transports and galleys and 5000 sailors and marines, in September 325 BCE. The entire voyage to the mouth of the Euphrates, with many wanderings and delays, took 130 days. As Nearchus first sailed down the Indus river to pattala, his voyage represents a rpecise example of how the lapis lazuli of Afghanistan could have reached Mesopotamia.

"The voyage of Nearchus was not the first recorded example of a voyage from India. According to Herodotus, the Persian king Darius (522-486 BC) ordered the Ionian admiral Scylax of Caryanda to make a voyage from India to Egypt, a journey said to have lasted three months. Scylax set sail from 'the city of Caspatyrus in the Paktyan country,' a site which cannot be securely identified but which, according to another passage in Herodotus, is to be placed in northern India near Bactria. According to R. Carpenter, the description in Herodotus '...best suits the borderland between modern Pakistan and Afghanistan.' Here, then, is another voyage down the Indus river and then west across the Arabian Sea. Such voyages, from Egypt to India, became very common by the early years of the Roman Empire. Strabo says that, in the reign of Augustus, as many as 120 ships a year sailed from the Red Sea ports of Myos Hormos and Berenice for northeast Africa and India. By the time of the emperor Tiberius, when the Greek explorer Hippalos discovered the monsoons and direct voyages to Bombay became possible, the traffic to India became so extensive that Tiberius began to worry about Rome's balance of payments. Roman hard currency was leaving the country to pay for the gems and silks of India. The so-called *Periplus of the Erythraean Sea* describes this trade in detail. At the time this text was written (late first century AD) India was importing copper, tin, and lead. Her exports included such items as ivory, agate, carnelian, pearls and tortoise shell, many of which are familiar as items associated with the Meluhha trade...

"The archaeological evidence...suggests that such contacts (between Mesopotamia and the Indus Valley) began already in the Early Dynastic period and came to an end with the close of the Isin-Larsa period. In general terms, the dates 2500-1900 BCE give the approximate time range for the contacts between the two areas. The period of Mesopotamian contact seems to coincide with the period of Harappan civilization itself. That such contacts were by sea is suggested not only by the geographical setting and the known historical background, but also by references in the Mesopotamian texts to ships from Meluhha. The first such reference comes from *Sammeltafel* text, in abilingual passage relating to the reign of Sargon of Akkad. It refers to the ships of Meluhha, Magan and Tilmun which are docked at the quay of harbor of the city of Agade. The ships of Meluhha are mentioned in other Mesopotamian texts, including one which actually comes from the Old Akkadian period and is not a later copy. Another Old Akkadian text seems to refer to a sailor of a Meluhhan ship. The Sumerian myth known as *Enki and the World Order*, refers to the *magilum*-ship from Meluhha which brings gold, silver, and lapis lazuli to Nippur. The myth of *Enki and Ninhursanga* refers to the big ships brought from Meluhha. These references suggest that a Meluhha ship was a ship which came from Meluhha and that the trade with Meluhha was in the hands of the inhabitants of the Indus Valley. The presence of 'an official interpreter of the Meluhhan language' in Mesopotamia helps to confirm this impression. The most extensive description of Meluhha in cuneiform literature comes in the Sumerian myth of *Enki and the World Order*. In the translation by S.N. Kramer, the relevant passage reads:

He proceeded to the land of Meluhha,
Enki, the king of Abzu, decrees (its) fate:
'Black land, may your trees be large trees, may they be 'highland' trees,
May their thrones fill the royal palace,
May your reeds be large reeds, may the be 'highland' reeds,
May the heroes in the place of battle wield their weapons,

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May yourbulls be large bulls, may they be 'highland' bulls,
May their cry be the cry of highland wild bulls,
May the great *me's* of the gods be perfected for you,
May all the *dar* birds of the highland wear carnelian beards,
May your bird be the *Haia* bird
May its call fill the royal palace,
May your silve be gold,
May your copper be tin (and) bronze,
Land, may everything; you have increase,
May your people multiply...

"This passage mentions a number of objects associated with Meluhha and listed elsewhere as coming from Meluhha. All of these items can be found in either Afghanistan or India and sometimes in both. Lapis lazuli has already been mentioned. It is found in Badahshan in northeastern Afghanistan. Carnelian is found in India. Gold, silver, and copper are all found in Afghanistan. They are also found in India. Gold has a particular association with India and there is extensive evidence for gold mining, both ancient and modern, in India, especially in the Kolar gold field, Mysore state. Gold also had a special connection with Meluhha, and the cuneiform texts refer to 'gold in its dust' from Meluhha. They also refer to silver from Meluhha. The copper from Meluhha has already been discussed.

"Besides the various stones and metals already mentioned, other natural products, said to be from Meluhha, are to be found in either India or Afthanistan. Ebony, the wood of Meluhha, is to be found in India. Ivory, said to be from Meluhha, is also from India, as is tortoise shell, which may also be another export from Meluhha. Among the birds mentioned in these texts the *dar-me-luh-ha mushen*, a variegated bird, is now thought to be some sort of chicken. The Meluhha species was known in Mesopotamia only from representations carved in ivory. The *dha-ja mushen* can now be identified as the peacock, the Indian bird par excellence. Both the dog and the cat are said to be from Meluhha, and there is evidence that both animals were domesticated by the inhabitants of the Indus Valley in Harappan times. Even the monkey may be associated with Meluhha, and there may also be an etymological connection as shown by the various words for 'monkey'.

"These are the principal products associated with the Meluhha trade. They represent exports from Meluhha, brought to Mesopotamia by traders from Meluhha in Meluhha ships...The same articles mentioned in the literary and historical texts appear as imports in the mundane economic texts of the Third Dynasty of Ur. All of the products said to be from Meluhha can be localized in Afghanistan or in the Indus Valley. This is in agreement with the generally accepted identification of Meluhha with the area of Sind and western Pakistan...The termination of this trade now seems to coincide with the collapse of Harappan civilization itself. This collapse may even be in some way responsible for the general economic decline in Mesopotamia and the absence of international trade after the Isin-Larsa period, i.e. after ca. 1900-1850 BCE...The lapis lazuli of Badahshan and the other stones and metals of Afghanistan must have been brought down the Indus river to some port on the mouth of the Indus. From Afghanistan the trade route must have gone south, over the Hindu Kush by means of the Khyber Pass to Peshawar. The Peshawar plain was known to the Persians as the satrapy of Gan-dh-a_ra and, from at least the sixth centyr BC, on, there existed a major trade route across Peshawar down to southern India. The cities of Cha_rsadda_ and Taxila testify to the importance of this route. Somewhere near the mouth of the Indus there must have been a port similar to that which Alexander the Great had built at Pattala, and from here the goods were shipped west eventually to reach southern Mesopotamia.

"It is generally assumed that such a port has been found and that it is located not on the Indus but at Lothal in the Gulf of Cambay...The radiocarbon determinations from Lothal suggest that the site was in use aproximatey in the period during which the trade with Meluhha was in existence.

"Although no actual remains of boats were found, the excavations at Lothal did uncover terracotta boat models and a number of so-called anchors of stone. It seems that industry was located right at the harbor site, for at Lothal were excavated not

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only factories for making agate and carnelian beads, but also the workshops of coppersmiths together with ingots of almost pure copper...

"The quay (Sumerian kar, Akkadian ka_rum) is mentioned frequently in cuneiform literature and was a major factor in the economic organization of ancient Mesopotamia...The quest for metals was the factor which stimulated the trowth of an organized foreign trade. The trade with Tilmun, Magan and Meluhha must, then, be seen as part of the international age of metallurgy which developed in the second half of the third millennium BCE.

"The tin of Meluhha may even have something to do with the Harappan settlement at Lothal. The use of tin-bronze in the Harappan period has been outlined above. Of particular interest is the extensive use of tin-bronze at Rangpur in Gujarat. The bronzes here have a tin content of four to eleven percent. The absence of arsenic in the Rangpur bronzes and its presence in the bronzes from Harappa and Mohenjodaro indicates taht different sources of copper were used in each area. That used at Rangpur must have come from Rajasthan and this is the ore also worked at Lothal, because arsenic is also absent from the copper ingots found there. This indicates that the Harappans did not come to Lothal to obtain copper. They might have come in order to obtain tin...it should be pointed out that Gujarat has even been proposed as possible location for Meluhha." (J.D. Muhly, 1973, *Copper and Tin*, Hamden, Connecticut, Archon Books, pp.241-335).

[5] **Euphrates the copper river or URUDU and Tin from Meluhha**

"A copper trade down the Euphrates is extremely ancient; the river's original name was Urudu or 'copper river'. (Hawkes, J. (ed.), 1977, ***The First Civilizations***, London, Pelican: 159, 167-8)...The whole purpose of sending Assyrian merchants to Anatolia was to ensure a steady supply of Anatolian silver and some gold. In exchange they gave cloth and tin, 'transported by caravans of black donkeys bred in Assyria'. They made a profit on the cloth of 100% and on the tin of 75-100%. The quantities traded could be considerable; a cargo of 410 talents of tin (more than 12 t) is once mentioned, though for some curious reason tin prices are never recorded. Trade with Kanesh continued until ca. 1757 BCE when Hammurabi of Babylon destroyed Mari (900 km. up the Euphrates) and a period of wars followed which reduced 'central Anatolia, once rich, to a land of ruins'. The Kanesh tablets give no indicatin of where Assyrian tin came from...The texts from Mari show a way out of the difficulty by also recording tin being shipped up the Euphrates, presumably from the Persian Gulf, pointing to a distant origin involving maritime trade...The Arab geographer Muqadasi stated that tin occurred at Hamadan, 560 km south-west of Tehran. As Muhly wrote, 'a mineral zone running roughly from Hamadan to Tabriz seems to fit all the evidence for the Near Eastern tin trade'. (Muhly, J.D., 1973, *Copper and Tin: the distribution of mineral resources and the nature of the metals trade in the Bronze Age*, Hamden, Connecticut, Archon Books, p. 409)...

"Tin from 'Meluhha'...According to the Larsa texts, merchants were there (in Mari and Larsa) to purchase copper and tin: the copper came from Magan in Oman, via Tilmun (Bahrain), but the origin of the tin is left in question. Tin mines in north-west Iran or the Transcaucasus are highly unlikely. Fortunately, there is evidence for another tin source in texts from Lagash. Lagash, about 50 km east of Larsa, was of minor importance except under the governorship of Gudea (ca. 2143-2124 BC). His inscriptions indicate extensive trade: gold from Cilicia in Anatolia, marble from Amurra in Syria, and cedar wood from the Amanus Mountains between these two countries, while up through the Persian Gulf or 'Southern Sea' came more timber, porphyry (strictly a purplish rock), lapis lazuli and tin. (Burney, 1977, 86; Muhly, 1973, 306-7, 449 note 542; Muhly, J.D., 1973, Tin trade routes of the Bronze Age, Scientific American, 1973, 61, 404-13). One inscription has been translated:

Copper and tin, blocks of lapis lazuli and ***ku ne*** (meaning unknown), bright carnelian from Meluhha.

"This is the only reference to tin from Meluhha...either Meluhha was a name vague

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enough to embrace Badakhshan (the northernmost province of Afghanistan) as well as some portion of the Indian subcontinent including the Indus valley, or 'tin from Meluhha' means that the metal came from some port in Meluhha -- just as 'copper from Tilmun' means copper from elsewhere shipped through the island of Bahrain. Whichever interpretation is correct, the result is the same. Tin must have come from somewhere in India, or from elsewhere along a trade route down the Indus valley. India is not without its tin locations, rare though they are...The largest deposits in India proper are in the Hazaribagh district of Bihar. 'Old workings' are said to exist... (Wheeler, R.E.M., 1953, *The Indus Civilization*, CUP, 58)...Tin bronzes from Gujarat are at the southernmost limit of Indus influence. The copper could have come from Rajasthan, though copper ingots at the port of Lothal, at the head of the Gulf of Cambay, suggest imports from Oman or some other Near Eastern copper mining district. Tin supplying Harappa and Mohenjo-daro, most famous of the Indus cities, may have been sent overland to Lothal for export, though the scarcity of tin in the Indus cities makes this idea unconvincing.

"At Harappa, three copper alloys were used in the period 2500-2000 BC: copper and up to 2% nickel; copper and up to 5% nickel; copper with ca. 10% tin and a trace of arsenic. Ingots of tin as well as of copper were found at Harappa. (Lamberg-Karlovsky, C.C., 1967, Archaeology and metallurgy in prehistoric Afghanistan, India and Pakistan, *American Anthropologist*, 1967, 69, 145-62). The rarity of the metal is seen at Mohenjo-daro where, of 64 artifacts examined, only nine were of tin bronze. (Tylecote, R.F., 1976, *A History of Metallurgy*, The Metals Society, p. 11). Ingots of tin bronze have also been found at Chanhu-daro. Yet in spite of its scarcity, tin bronze was widely used. Its occasional abundance and, in the case of the bronzes from Luristan in southern Iran, the high quality of the tin bronzes produced, equally underline the fact that rich source of tin existed somewhere...

"The archaeological evidence from Afghanistan is not unequivocal...What is surprising is the discovery in 1962 of corroded pieces of sheet metal bearing traces of an embossed design and made of a low tin content bronze (5.15%)...The uncorroded metal is thought to have contained nearer 7% tin. (Caley, E.R., 1972, Results of an examination of fragments of corroded metal from the 1962 excavation at Snake Cave, Afghanistan, *Trans. American Phil. Soc.*, New Ser. , 62, 43-84). These fragments came from the deepest level in the Snake Cave, contemporary with the earliest occupation dated by 14C to around 5487 and 5291 BCE. (Shaffer, J.G., in Allchin F.R. and N. Hammond (eds.), 1979, *The Archaeology of Afghanistan*, Academic Press, 91, 141-4)...If this dating is acceptable, not only is this metal the earliest tin bronze known from anywhere, but it is also an isolated occurrence of far older than its nearest rival and quite unrelated to the main development of bronze age metallurgy...

"Even more exciting is the evidence from Shortugai. Since the discovery of the first Indus finds at Harappa in 1921, the sphere of influence of this civilization has been greatly extended, first southwards to Gujarat and the Makran coast of Baluchistan, and now into northern Afghanistan. In 1975, French archaeologists discovered on the surface at Shortugai, sherds of Indus pottery extending over more than a millennium - the whole span of the Indus civilization. (Lyonnet, B., 1977, Decouverte des sites de l'age du bronze dans le N.E. de l'Afghanistan: leurs rapports avec la civilisation de l'Indus, *Annali Instituto Orientali di Napoli*, 37, 19-35). The sites are clustered above the confluence of the Amur Darya and the Kokcha. Finds also included gold and, nor expectedly, much lapis lazuli. Particularly important is a Harappan seal bearing an engraved rhinoceros and an inscription which reinforces the belief that the site was a trading post. Shortugai is only 800 km from Harappa, as the crow flies, though the journey involves hundreds of kilometres of mountainous terrain through the Hindu Kush...Lyonnet's conclusion was that the most likely explanation for their existence was an interest in 'the mineral resources of the Iranian Plateau and of Central Asia', to which can now be added those of Afghanistan itself. Indus contacts extended well into Turkmenia where the principal bronze age settlements, such as Altin-depe and Namasga-depe, lie close to the Iranian border.

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Imports here include square and oval gaming-counters of Indian ivory, and decorated sticks, numerous at Mohenjo-daro, related to types described in Sanskrit texts as being used in fortune-telling. The flat daggers of southern Turkmenia also closely resemble Harappan types...

"A fine copper axe-adze from Harappa, and similar bronze examples from Chanhu-daro and, in Baluchistan, at Shahi-tump, are rare imports of the superior shaft-hole implements developed initially in Mesopotamia before 3000 BCE. In northern Iran examples have been found at Shah Tepe, Tureng Tepe, and Tepe Hissar in level IIIc (2000-1500 BC)...Tin was more commonly used in eastern Iran, an area only now emerging from obscurity through the excavation of key sites such as Tepe Yahya and Shahdad. In level IVb (ca. 3000 BC) at Tepe yahya was found a dagger of 3% tin bronze. (Lamberg-Karlovsky, C.C. and M., 1971, An early city in Iran, *Scientific American*, 1971, 224, No. 6, 102-11; Muhly, 1973, Appendix 11, 347); perhaps the result of using a tin-rich copper ore. However, in later levels tin bronze became a 'significant element in its material culture' comparatble with other evidence from south-east Iran where at Shadad bronze shaft-hole axes and bronze vessels were found in graves dated to ca. 2500 BCE. (Burney, C., 1975, *From village to empire: an introduction to Near Eastern Archaeology*, 1977, Phaidon). The richness of Tepe Yahha, Shahr-i-Sokhta, and Shadad, are all indicative of trade and 'an accumulation of wealth unsuspected from the area'. (Lamberg-Karlovsky, 1973, reviewing Masson and Sarianidi (1972) in *Antiquity*, 43-6)....Namazga-depe and neighbouring sites are a long way from the important tin reserves of Fergana...The origin of Near Eastern tin remains unproven; the geological evidence would favour the deposits of Fergana and the Tien Shan range..." (Penhallurick, R.D., 1986, *Tin in Antiquity*, London, Institute of Metals, pp. 18-32).

[6] **Carpentry, chariot-making and house-building in the Vedic Age**

"Carpentry: The importance of this craft even in the Indo-European stage is indicated by words like 'taks.an', in Sanskrit, 'tashan' in Zend Avesta and 'tektan' in Greek. Taks.an meaning a carpenter is mentionedn in RV (RV 9.112.1) and later Vedic texts (AV 11.6.3; KS. 12.10; MS 2.9.5; VS 16.27 and 30.6; TB 3.4.2.1; SB 1.1.3.12). The carpenter made carts (s'akat.a and s'akat.i_) as referred to in RV (RV 10.146.3), Nirukta (6.22 and 11.47) and Cha_nd Upa. (4.1.8). Chariots (ratham na tas.t.eva: RV 1.61.4) and boats and ships (na_veva) (RV 1.61.4). Kulis'a, axe was one of the tools of the carpenter for the making of chariots (ratham na kulis'ah samr.n.vati: RV 3.2.1). The r.c (tas.t.eva pr.s.tya_mayi_:RV 1.105.18) refers to the fact that a carpenter bends over his work till his back aches...The carpenter made three types of bedsteads, talpa, pros.t.ha and vahya, referred to in RV (pros.t.hes'aya_ va_hyes'aya_ na_ri_-r-ya_-s-talpas'i_vari_h: RV 7.55.8; cf. AV 5.17.12)...The TS mentions instruments offering like 'sphya', 'vighana', pars'u' and 'pares'u'. (TS 3.2.4.1; cf. AV 8.28)...

"Besides, we find mention of kos'a (kos'am na pu_rn.am vasuna_: RV 10.42.2; cf. AV 1.14.4) in the RV meaning a box and bowls (dhis.ana) (RV 6.8.3; AV 19.49.8) some of which were decorated with carvings...We find the mention of the word 'druhantara' in the RV (1.127.3) meaning the destroyer of foes, which may be taken in the sense of a wood-cutter, as reflected in the simile (paras'u-r-na) here. The wood-cutter was then a very useful member of the society, as he supplied wood as fuel to the people and as raw material to the carpenter and because he cut and felled trees with axes, as reflected in the RV (RV 10.28.8; 1.32.5) and thereby helped the making of roads in the country abound with forests...Carpenters were never looked down upon in the society and rather their works were ever appreciated in the then rural societies for their usefulness in agriculture, as reflected in TS (taks.abhyo rathaka_rebhyas'cha vo namo namah: TS 4.5.4.2). Carpenters built also houses made generally of wood, as reflected in the RV where Brahman.aspati is said 'to have fashioned the earth and heaven from wood as carpenteres fashioned wooden houses'. The AV (AV 9.3.24) describes the different features of a dwelling house and the verse no. 24: 'like a woman, O dwelling, we carry thee where we will' suggests that the house was made of wood, light

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enough to be carried, whenever required. The houses were fixed in the ground with wooden pegs, as reflected in r.c (...da_dartha pr.thivi_m-abhito mayu_khaih: RV 7.99.3) and they rested on wooden pillars (...sthu_n.eva jana_n~ upamidyayantha: RV 1.59.1). The AV (AV 10.3) gives us to understand the different parts of the house, beams, ties, binding grass, roofs, supported by props, and cross-beams, consisting of 'thousand-eyed net' (aks.u), stretched out as 'opas'a' on the division-line' (Verse 8).

"'Ratha' in the RV means a chariot (RV 1.20.3), as opposed to anas (cart) and its nave (kha) was greater than that of a cart (RV 8.91.7). The wheel consisted of a rim (pavi), a felly (pradhi), spokes (ara) (RV 1.321.5 and 5.13.6) and a nave (nabhya). The rim and the felly together were known as the 'nemi'. Its axle (aks.a) was made often of 'arat.u' (RV 8.46.27) wood and the pole *i_s'a_ or prauga) was fixed at right angles to the axle. The horses wre tied by the neck where the yoke was placed and also at the shoulder by traces (ras'mi or ras'ana_). While the cart was drawn by oxen, the chariot was drawn by horses, normally two except in some cases three or four. (*Ved. Ind.* II, p. 202)

"Ratha_kara as a class attained reputation in the R.gvedic society, as his skill was compared to that of a poet (ratham na tas.t.eva tatsina_ya), evidently because a chariot was very useful for war and also as a vehicle of very important persons in times of peace. As noted above, the TS refers to respectful salutation to carpenters and chariot0-makers. The Bodha_. S'. S. (nedi_ya enam-ete karmakr.tta upasam.gacchante taks.a_n.a-s'-cha rathakr.ta_-s'-cha maya kr.tas'cha kula_la_s'cha dvaya_h kaar5ma_ra_h nakhakr.tah saptame) indicates the separation of two classes, carpenters and chariot-makers. In As'vamedha the carpenter was asked to make sacrificial posts, wooden vessels, carts, mats etc., while the chariotmaker (rathaka_ra) was asked to manufacture chariots. Chariots were made of s'in~sapa wood (RV 3.53.19) but the pin of its axle (a_n.i) was made of kha_dira, wood. The wheels of chariots were usually made of s'almali_ wood. (RV 10.85.20). The AV (AV 3.5.6) refers to chariotmakers as clever workers and as one of those who are to be subject to the king, indicating thereby the importance of this industrial class. The Rathaka_ras had attained social prestige so as to form a separate caste, as attested by VS (VS 16.17 and 30.6), TB (TB 1.1.4.8) and S'B (S'B 13.4.2.17). Hillebrandt (*Vedische Mythologie*, 3.152,153). suggest that 'the Anu tribe formed the basis of the Rathaka_ra caste, referring to their worship of the R.bhus, who are, of course, the chariotmakers par excellence', but the learned authors of the Vedic Index do not agree with this view. (Vol. I, II, p. 204). The Ka_tya_. S'.S. howeever, refers to the rathaka_ra as a s'u_dra. (KS'S. 1.1.9). But there is little doubt that this classs was highly esteemed in the Vedic period for their skill, as noted before. In the later period the Rathaka_ra was raised to a higher level and regarded as competent to be 'upani_ta' and to perform s'rauta sacrifices."

"Gaya is a common term for a house in the RV (5.10.3; 44.7; 6.2.8) and later texts (AV 6.3.3 and 84.1; VS 27.3); so also dama (RV 1.1.8; 61.9; TS 5.2.1.2; VS 8.24), dha_man (RV 1.144.1; 2.3.2; 3.55.10; 8.61.4; AV. 4.25.7; 7.68.1; VS 4.34; Tait. A_ran. 2.7.2) in the sense of a house and its inmates and also in that of an ordinance of law, aga_ra (Kaus. Upa. 3.15; A_s'v. Gr. S. 1.7.21) and gr.ha (RV 3.53.6; 4.49.6; 10.18.12; 85.26; AV 1.27.4; 3.10.11; AB. 2.31 and 8.21.26.; VS 2.32 and 4.33, S'B 1.1.2.22). Dur (RV 1.68.10) means door of a house (duron.a) (RV 10.40.13). Sthu_n.a (RV 1.59.1) means a pillar of a house. The AV (9.3) refers to the method of building a house by means of pros (Upamit), supports (pratimit) and connector (parimit). It mentions beams (vam.s'a), ties (nahana), binding grass (prana_ha), and the sides (paks.a) of the house.
The roof was formed of ribs of bamboo cane, a ridge called vis.uvant and a net (aks.u). The walls were filled up with grass in bundles (palada). This hymn refers to three parts of the house 'havirdha_na', i.e. oblation-holder, 'Agnis'a_la' (fire-place) and 'wives' site and seat (patni_na_m sadana') and 'sadas'. It speaks of hanging vessels (s'ikya_). **Posts were usually made of timber but some of them were made of metals like 'ayas', is evidenced byu the term 'ayasthu_n.a' (RV 5.62.8) used in connection with a chariot.** (emphasis added). A large building, unparalleled

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among people is also refer4red to in the r.c (RV 10.47.8) for which the sage saptagu prayed to Indra.

"The Dasyu-s, i.e. the pre-Aryan people, at least their chiefs lived in cities, built of iron or of stone in the Vedic age, as evidenced by the r.cs. (RV 1.53.8, 1.103.31, 2.20.8 and 4.30.20): (1) tvam s'ata_ vam.gr.dasya_bhinat puro... (2) ...puro vibhindam-nacharat vi da_si_h... (3)...hatvi dasyu_n pura a_yasi_-r-nita_ri_t and (4) s'atam as'man-mayi_na_m pura_m-Indro vya_syat. The forts of kings had a thousand pillars (sahasrvasthu_n.a) (RV 2.41.5) and a thousand doors (sahasra-dva_ram) (RV 7.88.5). Indra is said to have killed the asuras or dasyu-s and to have helped his Aryan worshippers thereby, so that they would occupy the cities or castles, made of iron or stone. We hear of bricks, man.d.ales.t.aka (circular bricks) (TS 5.3.9), Vikarn.i_ (cornerless bricks) (TS 5.3.7) and chod.a_ (conical bricks) (TS 5.3.7) and bricks were made firm by mortar (puris.a) (TS 5.3.2). The rich lived in a house, built on 'foursided roof (chatuspaks.am-iva cchadih) (AV 3.7.3) or in a harmya -- harmyes.t.ha_h (RV 7.56.16), a house including the stabling etc. The sage Bharadva_ja prayed to Indra, for a house, tridha_tu and trivaru_tha. (RV 6.46.9). Here 'tridha_tu' means, according to Sa_yan.a, of three types (tri-praka_ram) or of 'three stories' (tri-bhu_mikam). Three types may be houses made of wood, brick or stone or of three different apartments, one of stone, the others of wood or brick. 'Tri-varu_tha' means, according toi Sa_yan.a, houses saving inmates from cold, heat and rains. (S'i_ta_tapa-vars.a_n.a_m va_rakam). The houses prayed for were built on roofs (cchardih), strongly built (Svatimat)...

"Charioteer; The RV (RV 1.144.3; cf. 1.55.7; 2.19,6; 6.20.5; 10.102.6) mentions a charioteer driving the car, holding fast the rein (ras'mi_n samayam.s.t.a sa_rathih), sometimes whipping the horses (pa_rs.n.ya_ va_ kas'aya_ va_ tutoda in: RV 1.162.17). Indra placed his charioteer just by his side, as stated in the r.c (uru s.a saratham sa_rathaye karindrah kutsa_ya su_ryasya sa_tau : RV 5.20.5) and this helps us to understand the prestige of a charioteer in the R.gvedic age. The respectable position of a charioteer is also attested by the AV (AV 15.2.1) and VS (VS 16.26)
[Haripada Chakrabarty, 1986, *Socio Economic Life of India in the Vedic Period*, Calcutta, Sanskrit Pustak Bhandar, pp. 228 to 237].

[7] Extracts from: 'Discoid Weapons in Ancient India: A study of Vedic *cakra*, *pavi* and *ks.urapavi'* O.H. DE A. Wijesekera, *Adyar Bulletin*, Vol. XXV, 1961, pp. 250-267:

Of the weapons of attack mentioned in the ancient literatures of India the *cakra*, quoit, or discus, appears to be an implement peculiar to the Indian warrior's armoury, for it is hardly found in other cultures. Apart from its lexical citations, the references to this weapon occur mostly in mythical or legendary contexts, especially in Epic mythology where it is best known as the battle-disk Sudars'ana of Vis.n.u-Kr.s.n.a, Va_sudeva or Na_ra_yan.a. [See So_rensen, *An Index to the Names in the Maha_bha_rata*, p. 653 (s.v. Sudars'ana)]. In the MBh it is significanly referred to as being 'hurled with force from the hands of Vis.n.u' (I.1103, 1188), and Kr.s.n.a is stated to have cut Saubha in twain by means of the Sudars'ana (III.883). That a weapon, not merely an ornament, was implied by the Epic writers is further clear from Kr.s.n.a's epithet *cakra_yudha* found in the MBh (V.56; XV.665; cf. I.1163), *Harivam.s'a* (5800, 9242) and the *Ra_ma_yan.a* (VI.102.12), a use with which may be compared the term *cakrayodhin*, 'discus-fighter', applied to a Da_nava in the *Vis.n.u P.* (I.21.12). Most conspicuous among the gods of Epic and Pura_n.ic mythology as wielder of the *cakra* is doubtless Kr.s.n.a and such epithets as *cakradha_rin*, *cakra(gada_)bhr.t*, *cakra(gada_)dhara*, *cakrapa_n.i*, and *cakra_yudha* are applied especially to Kr.s.n.a, or to Kr.s.n.a *qua* Vis.n.u and in a few instances to Vis.n.u himself. (ibid., pp. 171, 421, 747). The *Bhagavadgi_ta* (XI.46) describes the Kr.s.n.a-Vis.n.u epiphany as *cakrahasta*, 'having a discus in hand', and the *Harivam.s'a* (8193, 8376) applies the epithet *cakrapa_n.in* to the same. The discus of Vis.n.u is also referred to in the *Vis.n.u P.* (I.13.46) and the *Vara_ha P.* gives an allegorical interpretation of Vis.n.u's *cakra* as 'the Cycle of Time', (See V.R. Ramachandra

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Dikshitar, *War in Ancient India*, p.148), doubtless echoing RV, I.155.6. Another symbolic representation of the idea is found in the *Ra_ma_yan.a* (N.W.IV.35; cf. *Hariv.*, 12408, 12847). The *Ra_ma_yan.a* also mentions along with Guhyaka-s and Suparn.a-s a class of semi-mythical beings called the *cakradhara-s* (V.44.22), which is probably explained by the MBh reference to the Siddha-s as *cakradhara-s* (XIV.429). In the *Bha_gavata P.* (I.9.4) Kr.s.n.a appears as *cakrin* and S'iva himself receives that appellation in the MBh (XIII.745). That the term *cakradhara* is probably earlier than the Epic period may be inferred from its incidence in the *S.ad.vim.s'a Br.* (V.10) and the *Adbhuta Br.* (10). It is extremely significant that the term *cakradhara* is used in the MBh (III.8221) for a 'universal monarch' or emperor, an idea which may throw considerable light on the meaning of the famous epithet *cakravartin* which perhaps occurs in Sanskrit literature for the first time in the *Maitri U.* (I.4) if the *Br.haddevata_* reference (V.123) is considered posterior.

Apart form the above allusions of a mythical character, there are several references in the Epic and later Sanskrit literature which prove that the *cakra* was a real weapon wielded by human warriors and which also provide some knowledge of its construction and method of use. The MBh itself refers in one place to an actual warrior as *cakradhara* or 'discus-bearer' (I.6257). The same Epic (I.33.2 ff.) describes the weapon *cakra* as being made of iron (*ayasmaya*) and sharp-edged (*ti_ks.n.adha_ra*) and adds that it is cast by revolving or whirling (*paribhrama*). The *Matsya P.* (150, 195) defines it as a wheel having eight spokes and besmeared with oil. (Cf. Chakravarti, *The Art of War in Ancient India*, pp. 171 ff.). According to the *Va_mana P.* (79) the *cakra* has lustrous and sharp edges. Kaut.ilya (II, ch. 18) defines it as a *calayantra*, probably meaning a 'projectile mechanism'. Of the classical texts, the *Raghuvam.s'a* (VII.46) characterizes this weapon as *ks.ura_gra*, that is, as Mallina_tha understands it, 'whose edge is as sharp as that of a razor'. The *S'is'upa_lavadha* of Ma_gha (XVIII.45) describes it as a weapon which is hurled from a distance and cuts off the limbs of the enemy. The very late text on diplomacy, the *Ni_tipraka_s'ika_*, enumerates among the projectile or *sopasm.ha_ra* weapons four kinds of *cakra-s*: the *dan.d.a-cakra* or the lethal discus, *dharma-cakra*, the wheel of righteousness, *ka_la-cakra*, the discus of Death, and *aindra-cakra*, the discus of Indra. (Cf. *S'ukrani_ti*, ch. IV, sec. VII, 1.430, for three kinds of quoits). It further says (IV.47) that the weapon is a circular disc (*kun.d.ala_ka_ra*) with a triangular hole in the middle. The *Agni P.* (252.8) defines the techniques of handling the discus, and the *S'ukrani_ti* gives five or seven motions connected with the hurling of the weapon. Commenting on this passage, Oppert says that the *cakra* 'is most probably identical' with the quoit still in use in some Sikh regiments and also among the troops of native Indian princes'. (*On the Weapons etc. of the Ancient Hindus*, p. 15). Reference may also be made to representation of *cakra-s* in sculpture. In the Sim.hala fresco at Ajanta discoid weapons are seen to fly through the air. Hindu iconography shows several examples of *cakra-s* zome with spokes as in the chariot-wheels and others with spokes shaped like the petals of the lotus. (See Gopinatha Rao, *Elements of Hindu Iconography*, vol. I (*a_yudha-purus.a-s*). In some of these the sharp edges are distinctly marked. A few examples of Vis.n.u's discus also occur in sculpture. (Bhattasali, *Iconography of Buddhist and Brahmanical Sculptures in the Dacca Museum*, p. 78; cf. Zimmer, *Myths and Symbols in Indian Art and Civilization*, pp. 76, 78). Thus although most of the notices concerning the *cakra* as discus or quoit occur in the sphere of myth and legend, there seem to be sufficient grounds for inferring that in ancient India in actual weapon by that name was in use. In fact, in a South Indian text, the *Kalingattu Paran.i*, it is said that it was part of a prince's education to be trained in the use of 'the five kinds of weapons, beginning with the discus'. (See *Indian Antiquary*, 19, 332). Moreover, certain epigraphic references too seem to confirm this idea. (*South Indian Inscriptions*, vol. I, p. 153; *Corpus Insc. Indic.*, vol. III, p. 184, etc.)

In view of the above evidence for the existence of a real discoid or quoit-like weapon in post-Vedic India, it becomes an interesting problem to seek to discover whether such an implement of attack is found in the warlike culture of the RV. Such a

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weapon if it existed would naturally be mentioned in connection with the more bellicore deities, particularly Indra and the Marut-s. And this is exactly what we find in the hymns of the RV. Among the weapons used by Indra against the Asura-s and other opponents we do find mentioned a *cakra*, or sometimes a *cakri_* of which the suffix *-i* may be regarded as only pleonastic on the authority of Wackernagel. (*Altindische Grammatik*, vol. II, pt.2, 247 e). At RV, VIII.85 (=96).9, Indra is implored to scatter, aided by the Marut-s the godless and weaponless Asura-s with the *cakra (ana_yudha_so asura_ adeva_s' cakren.a ta_m apa vapa r.ji_s.in)*. Griffith in his translation has a note to the effect that *cakra* here means the 'discus, a sharp-edged quoit used as a weapon of war' (*Hymns of the Rigveda*, vol. II, p. 245) and Wilson actually translates it as 'discus' (*Rigveda*, vol.V, p. 183). Sa_yan.a's comment *cakraru_pen.a vajren.a* shows that he regarded it as a weapon of discoid shape but was doubtful as to its specific function as a club or projectile. Similarly at RV, II.11.20, Indra is reported to have 'hurled forth his *cakra* as the sun (sends his disk rolling), and, aided by the An:giras-es, rent Vala' (*avartayat su_ryo na cakram, bhinad valam indro an:girasva_n*); the figure of Su_rya rolling the solar disk is otherwise attested (e.g. VII.63.2). Sa_yan.a's explanation is as before: 'whirled his *vajra* for the slaughter of the Asura-s' (*asurahanana_rtham vajram abhra_mayat*). In another context (RV, II.34.9; cf. 14), the Marut-s are requested to 'save us from the inquirer, the mortal foe' and 'attack (lit. whirl at) him with the glowing (lit. heated) disk' (*vartayata tapus.a_ cakriya_bhi tam*). The use of heated missile in battle is referred to even in other places (e.g. *as'na_ tapus.a_*, RV II.30.4; *tapus.aim hetim*, III.30.17; cf. VI.52.3, VII.104.5). There is no doubt that the *cakri_* must have been made of metal (or stone?) to be able to be heated. In fact, Sa_yan.a understands some kind of javelinor dart in this instance (*r.s.t.ya_khyaya_ cakriya_*) and, in the same hymn, on *cakriya_* in verse 14 adds: *r.s.t.ya_khyena_yudhena*. Moreover, it is noteworthy that in the above examples the causative verb *vartaya-* is used in the sense of 'to hurl by rotatint' or' to send whirling'. Such a use is exemplified also in other contexts [See Grassmann, *Worterbuch zum Rig-veda*, s.v. *vr.t* (9,10)] both with the accusative object (weapon) and the dative of the victim as at RV, VII.104.4 (cf. I.121.9), and, with the instrumental of the implement and the accusative of the person attacked as in the passage under discussion and, for example at RV, VII.104.5. Such an idiomatic use of *vartaya-* may also be found at RV, V.30.7 and VIII.14.13. The sense of weapon for *cakra* is also clear from RV X.73.9 where the term obviously signifies the thunderbolt of Indra. Although this stanza has not been elucidated by Sa_yan.a for the RV, yet in his comment on the parallel passag at SV I.331, he gives the sense of *a_yudha* and Griffith renders it by 'quoit'. There is another instance of *cakra* at RV I.155.6 which seems particularly important in view of the famous connection with Vis.n.u with the discus already referred to. It is said there that 'like the whirling *cakra* he (Vis.n.u) has set in motion his ninety-four racing steeds' (*cakram na vr.ttam vyati_ravi_vipat*). Sa_yan.a's comment here is most illuminating: '*vr.ttam cakram na: bahvaropetam cakram iva tam yatha_ s'atror upari praks.epan.a_ya bhra_mayati...*' (like a *cakra* with many spokes, which he whirls with the intention of casting it on the enemy). It is certain that Sa_yan.a has at the back of his mind the celebrated discus Sudars'ana, the first of Vis.n.u's five weapons. For all these contexts Geldner in his translation (Reference is to Geldner's *Der Rig-veda* (HOS, vols. 33-5) and to Grassman's *Rig-veda* (2 vols.). Hereafter translations of the RV, will be cited by the author's name.) merely renders *cakra* by '*Rad*' (wheel) without commenting on its actual implication, probably following Grassmann who too groups all these under the simple sense of 'wheel' in his *Worterbuch* and gives the same sense in his translation.

The nature-myth imagery of the RV has in some places equated the solar disk (See Von Bradke, ZDMG, vol. 40, p. 357) with the*cakra*, and in some contexts Indra is said to have hurled at his enemies the solar disk, tearing off or plundering it from the sun (*svar, su_rya*). At RV, I.130.9 he is eulogized as having torn off (*pra br.hat*) the wheel of the sun (*su_ras*) and deprived his opponents (the tyrannous ones of verse 8) of their life (lit. speech). Sa_yan.a on this verse records a

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legend (*itiha_sa*) as to how Indra used the sun's disk as a weapon against the Asura-s. In another passage (IV.16.12), Indra is implored to 'crush the Dasyu-s at once...tearing off in the onslaught the disk of the sun' (*sadyo dasyu_n pra mr.n.a... pra su_ras' cakram br.hata_d abhi_ke*). This idea has an exact paralle at RV, I.174.5 where the poet says' let him tear the sun's disk off in the onslaught, let the thunderbolt-armed go forth to meet his rivals' (*pra su_ras' cakram br.hata_d abhi_ke abhi spr.dho ya_sis.ad vajraba_huh;* cf. V.29.10). We are not wrong, therefore, if we see the same idea of tearing off the sun's disk at RV, IV.28.2 where Indra is said to have wrenched (*khidat*) the disk of the sun, and in another passage where he is described as having plundered (*mus.a_yah*) the sun's *cakra* in the fight and driven away the evil-doers (Grassman, *Worterbuch zum Rig-veda*, s.v. *rapas.*) (VI.31.3; cf. I.175.4, IV.30.4). Just as in the above instances the authors of the hymns seem to have asociated the image of the sun's 'wheel' with the *cakra* as mythical weapon of Indra, so do they appear to have connected in their imagination the latter with the wheel of the war-chariot. In a much discussed context, namely RV, I.53.9, Indra is said to have 'beaten down (*ni... avr.n.ak*) with his evil-footed [Geldner takes dus.pada_ as 'with the lame', but Griffith as 'outstripped', following Sa_yan.a (s*'atrubhih pra_ptum as'akyena*), qualifying *cakren.a*. Grassman's 'evil-footed' (*Worterbuch*) seem, to suit the context better, meaning, as he gives in his trans., 'a sharp wheel', although previously the present writer gave the sense of 'unassailable' to the compound (Belvalkar Felicitation Volume, p. 266)] chariot-wheel (*cakren.a rathya_ dus.pada_*) the twice ten rulers of tribes... (who advanced)'. Whether we find here a reference to armed wheels of the war-chariots, as Whitney suggested for the term ks.ura-pavi of the AV to be discussed later, remains problematical.

From the above discussion it may be surmised that the *cakra* as a weapon of attack implies a 'crossing' of two or three poetical images. The stone discus as a primitive implement, probably surviving (See the present writer's paper on 'Some Prehistoric Survivals in the R.gveda', *Indologen-Tagung*, 1959, Gottingen, 1960) from the neolithic hunting cultures of the primitive Indo-European period (See V. Gordon Childe, *The Aryans*, pp. 160-1) may perhaps be the prototypal concept. That Stone Age primitive man might have already devised even in a crude and rudimentary form such an implement (a potential weapon of attack) is inferable from the sharp-edged discoid flakes that have been unearthed by archaeologist. (See Burkitt, *The Old Stone Age*, 2nd ed., pp. 68, 99; De Pradenne, *Prehistory*, Row's trans., pp. 58 ff.). Moreover, it is significant that in ancient Greece the massive *diskos* made of stone was popular, although as an object of sport. (Homer, *Odyssey*, VIII.186, 188, 190; *Iliad*, II.774; Pindar, I.1.34. Excavated specimens are circular plates of stone, later of metal, nine to ten inches in diameter and four to five pounds in weight. See *Encyclopaedia Britannica* (14th ed.), vol. V, p. 420). The throwing of the discus or the quoit had become a game as had the throwing of the javelin, both originally perhaps projectile weapons of attack. (Cf. the *bolas*, a primitive hunting missile, now used as a game or a toy in Africa. ibid., vol. 23, p. 454). In the R.gvedic period, however, the discus seems to have survived at least as the mythical weapon *cakra* used by Indra, with its nature-myth counterpart in the solar disk of the heavens. On this image already complex, mytho-poetic fancy apparently super-added (see RV I.53.9) the symbol of the *wheel* of the war-chariot whose popularization among Vedic Aryans must be soleley attributed to the chariot-warriors reflected in the characters of Indra and his hosts, the Marut-s. Indra indeed is the *rathes.t.ha_, par excellence*, the epithet being exclusively used for him in the RV. (See Grassman, Wb., s.v.; cf. Piggott, *Prehistoric India*, pp. 260, 273).

Th above attempt to establish the sense of R.gvedic *cakra* as referring in some contexts at least to a discoid weapon receives considerable support from an isolated instance of its occurrence in the Avesta. In a fragmentary text, the *Aogemadae_ca_* (81) we find the phrase *hae_naya_ cakhravaitya_*, which the Sanskrit commentary of Nairyosang has rendered by '*cakra-s'astra-dha_ri_*' that is to say, 'bearing the weapon discus or quoit'. In spite of Herzfeld's ingenious suggestion that the text may be

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referring here to a 'chariot-regiment' (*Zoroaster and His World*, vol. II, p. 687) -- *cakhra* in his opinion being used in this compound *pars pro toto* for the *ratha* -- one would rather agree with the traditional explanation, and regard the *cakhra* as a discus or quoit like the Vedic parallel. Bartholomae's interpretation of *cakhravant* here as 'bearing a wheel as field-badge (military emblem)' (*Altiranisches Worterbuch*, s.v. *cakhravant*-) is far more justifiable although he has offered no further explanation of its significance. If the meaning of discus or quoit be accepted for the Avestan word also, it may indicate an Indo-Iranian provenance for this particular weapon, which, as we had reason to surmise above, possibly survived into the R.gvedic period from an earlier era.

There is further evidence in the Vedic literature supporting the idea that the Aryans of the early period knew of a sharp-edged, circular metallic weapon of attack. It has been generally recognized that apart from its simple sense of wheel-band or tire of the chariot wheel (*Nirukta*, V.5: *ratha-nemi*) the word *pavi* also implies in a few instances in the RV some kind of weapon (See Grassman, Wb., s.v.; Geldner, *Ved. Studien*, vol. II, p. 12, f.n.1; Zimmer, *Altindisches Leben*, p. 248; Macdonell and Keith, *Vedic Index*, s.v.; Mayrhofer, *Kurz. Worterbuch des Altindischen*, s.v. *pavi*) although its exact character is not sufficiently clarified. This latter meaning, no doubt, is based on *Nirukta* XII.30 (=*s'alya*) and *Naighan.t.uka* II.20 (=*vajra*). Consequently *pavi* has been taken as 'metallic point of spear or arrow' or a 'bolt'. The etymology of this word is somewhat obscure (See ibid., *s.v.* pavi), but if connected with Latin *pavio_*, *pavi_re*, to strike or crush, Lithuanian *pjauti*, to cut or immolate, and probably also with Greek *paio_*(Pokorny, *Indogermanisches Etymologisched Worterbuch*, p. 821 (s.v. *pe_u*); cf. Mayrhofer, loc.cit., citing Charpentier, *Indian Linguistics*, II, 70 ff.; see also Grassman, Wb., loc.cit.), the meaning of some sort of weapon as Indian tradition pictured it is certainly plausible. It is significant that in some contexts of the RV the term *pavi* while obviously signifying the *tires* or rims of the chariot-wheels of the Marut-s (or the As'vin-s) also contains the suggestion of their being employed as rain-making implements (e.g. I.64.1, 180.1) reminding one unmistakably of the dual role of Indra's *vajra*. Perhaps it is the same idea that is implied at RV, I.88.2, where the Marut-s are said 'to strike the earth with the tire of their chariot' (*pavya_ rathasya janghananta bhu_ma*). These instance show a 'crossing' of the idea of *tire* and *weapon*, just as in the case of *cakra* as indicated above. It is, however, difficult to visualize an implement of the shape of a tire being used as a weapon, since in several contexts *pavi* is compared to a sharp blade, as of an axe, falling on the victim and chopping his trunk or limbs. On the other hand if the weapon is understood as some form of quoit which in the poet's imagination had sometimes been associated with the tire, on account of its circular metallic nature, the sense of several contexts seem to improve.

At RV, VI.8.5, Agni is implored to 'cut down the wicked (foe), as it were, with the *pavi*, like a tree with a sharp edge (of an axe) [cf. Geldner, HOS, vol. 34, p. 100[] (*pavyeva... aghas'am.sam.... ni_ca_ ni vr.s'ca vaninam na tejasa_*). Here Sa_yan.a equates *pavi* with *vajra*, as he often does for the term *cakra*. Griffith guesses with 'sharpened bolt', while Geldner cautiously takes it as 'iron weapon' (*Eisen*). What has to be emphasized here is the intended parallelism between *pavya_* and *tejasa_*, the latter, as Geldner has rendered it, meaning 'the sharpened edge (of a cutting instrument)' -- a sense several times found for *tejas* in the RV (See Grassman, Wb., s.v.). Hence by *pavi* reference to a weapon with extremely sharp edge, used with that edge striking the victim, is clear from this context. A similar appeal is addressed to Indra at RV, X.180.2 (= AV VII.84.3): 'Whetting they darting, sharp *pavi*, O Indra, dismember our foes...' (*sr.kam sam.s'a_ya pavim Indra tigmam vi s'atru_n ta_d.hi*). Sa_yan.a takes *sr.kam* as adjective to *pavim* in the sense of 'moving' (*saran.as'i_lam*) which seems preferable to regarding it as a noun with the meaning of a 'dart' as most translators have done. It is significant that both the verbs *ni vras'c* and *vi taks.* are most appropriate to describe the action of a sharp-edged weapon falling suddenly on the victim and severing his head or limbs from the trunk. We may compare the use of *vi taks.* at RV, I.158.5 (*s'iro yad asya*

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traitano vi taks.at). It would certainly be odd to conceive of a rim-shaped metal band being capable of such a function. It is only if we take *pavi* as a quoit that these contexts assume some intelligent meaning. In Particular, the difficult stanza at RV, X.156.3 becomes amenable to a reasonable interpretation if *pavi* is taken in that sense. There Agni is addressed with the words: '*an:gdhi kham vartaya_ pan.im*'. Grassman in his *Worterbuch* promptly suggested the emendation of the curious *pan.im* to *pavim* and in his translation gave the rendering 'turn the wheel'. He had the support of the SV (II.7.15.3) which reads *pavim*, the reading followed by Griffith too in his RV translation. Geldner, who is not enthusiastic about this emendation, renders the phrase (with *pan.im)* as 'smear the hole (of the hub) and turn (i.e. convert) the niggard', adding a note to say that the idea is figurative. Unfortunately for him such a sense of *vartaya* is nowhere attested in the RV, whereas its constant use in the sense of 'whirling' (such as wheels or discoid weapons) has lready been referred to as in the case of *cakra.* Griffith's 'oil thou the socket, turn the wheel' following Grassman seems much more reasonable, the only objection being that *pavi* never means the *wheel* of the chariot in the Veda or elsewhere. As shown earlier, it means only the metallic rim or tire round the wheel. If we regard *pavi* her as the weapon, i.e. some form of quoit, a positively clear meaning is attained. In that sense the oiling would refer to some application of a lubricant to the inside socket (*kham*) of the quoit for a swifter whirling and easy release. That some discoid weapons had a triangular hole in the middle has been recorded in the *Ni_tipraka_s'ika_* as referred to earlier. We may also compare the art of throwing the Greek *diskos* which was swung with the help of a helve of wood put into the hole. (Liddell and Scott, Greek Lexicon, s.v. *diskos*). In fact, the *Matsya P.* (150, 195) actually refers to the weapon *cakra* as being oiled, an idea which clearly supports the above interpretation.

In view of the above occurrences of *pavi* in the likely sense of a quoit, the incidence of the term *ks.urapavi,* 'razor-edged *pavi*', twice in the AV (XII.5.20, 55) assumes particular significance. In this hymn, inculcating the danger of robbing or harming a Brahmin's cow, it is said that 'she is a bolt (*vajra*) when running (18); a missile (*hetih*) when she draweth up her hooves... (19); a *ks.ura-pavi* when she beholdeth (20)'. Again, lower down (54-5) in the same hymn the cow is addressed: 'Burning, consuming, as the *vajra* of the Brahman, becoming Death, as the *ks.ura-pavi*, pursue thy course' (*ks.urapavir mr.tyur bhu_tva_ vi dha_va tvam*). In both these contexts Griffith translates the term by 'sharp as a razor' (*Hyns of the Atharvaveda*, II, pp. 128, 130). Whitney too taking it as an adjective renders it as 'keen-edged', but in the latter context adds a note that the reading *vi dha_va tvam* 'probably carries on the figure implied in *ks.ura-pavi* which applies especially to the armed wheels of a battle chariot'. (*Atharvaveda Sam.hita_* (HOS, vol.8), p. 706). Whitney possibly refers to the sense of *pavi* as 'tire' developing into that of 'wheel'. But such a semantic development is hardly attested in the language, as remarked earlier. Thus, considering also what has been said above regardin the meaning of *pavi*, it appears justifiable to conclude that *ks.ura-pavi* most probably was a weapon of the shape of a *flattish metal ring* with its outer edge as sharp as a razor blade. Further evidence as to the substantive 'weapon' sense of the term may be found in the *Taittiri_ya S.* (II.1.5.7) where, in a cryptic simile, Prosperity is compared to the *ks.ura-pavi* and the sacrificial post, shaped like a wooden sword, to the *vajra;* its terror-striking character being implied at V.6.6.1, VI.2.5.2, etc. (Cf. S'atapath Bra_hman.a, III.6.2.9; *Hiran.yakes'in Gr.hya-su_tra*, I.24.5). This substantive sense is also found at *Maitra_yan.i_ S.* I.10.14 (= *Ka_t.haka S.,* XXXVI.8) where the Marut-s are described as having destroyed the victim with the *ks.ura-pavi*, the *Nirukta* (V.5) glossing is as 'tire or wheel-band'. The *S'athapatha Br.* (VII.3.2.5,6) refers actually to *vajra_n ks.urapavi_n,* and with this may be compared the statement at *Jaimini_ya Br.* I.98 which equates *ks.ura-pavi* with *vajra.* It may be observed that *vajra*, although prominently used for the celebrated thunderbolt of Indra, in course of time assumed in the Vedic period itself the general sense of 'weapon'. (Monier-Williams, Sanskrit-English Dict., s.v. *vajra*).

Definite support for the above interpretation comes from the existence in Pali (*Ja_taka,* IV.3)

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of th eterm *khura-cakka* which is clearly conceived as a 'wheel' which immolates the victim by its rotation (ibid., p.4). Cowell (*The Ja_taka*, English translation, IV, p. 3) rendered the term as 'a wheel sharp as a razor'. The real character of this weapon is brought out in the phrase *khurapariyantena_pi cakkena* found in the *Digha Nika_ya* (I.52) which Rhys Davids translated as 'with a discus sharp as a razor' (*Dialogues of the Buddha*, I, p. 69), the Pali commentary on this passage (*Suman:galavila_sini_*, pt.I, p. 160) equating *khura-cakka* with *khura-nemi*, where *nemi* is the exact equivalent of *pavi* as shown earlier. It may be added that in Prakrit too *pavi* is found in the sense of *vajra*, the weapon of Indra (*Pais-sadda-mahan.n.avo* (pt.I), s.v.), a use which receives confirmation from the phrase (*vajren.a*) *ks.ura-bhr.s.tina_* at AV, XII.5.66, which Whitney has translated as 'razor-pronged (*vajra*)'.

The above discussion should throw some light on the obscure passage at RV I.166.10 where the Marut-s are described as 'having blades (razors) on their *pavi-s'* (*pavis.u ks.ura_ adhi*). Max Muller translated the phrase as 'on their fellies (are) sharp edges', suggesting, as Whitnely did for the AV *ks.urapavi* referred to above, 'armed wheels of a battle chariot'. However, he is doubtful 'whether in India or elsewhere the tires or the wheels of chariots were ever used as weapons of attack, as detached from the chariot...' (SBE, vol. 32, p. 173). Sa_yan.a says that weapons like the *vajra* with sharp edges is meant (*pavis.u vajrasadr.s'es.va_yudhes.u ks.ura_h ks.uradha_ra_h*), and, according to the context, *pavi* does not appear to imply any connection here with chariots. Considering the real nature of the other weapons carried by the Marut-s, it seems very probable that the reference is to some of sharp-edged quoit. Even more puzzling an occurrence of the term is found at RV V.31.5 which states that 'without steeds or chariots the *pavi-s* sped by Indra whirled upon the Dasyu-s' (*anas'va_so ye pavayo 'ratha_ indres.ita_ abhyavartanta dasyu_n*). It may be that this reference too is to rim-like quoits in their (horizontal) flight which the poet seems to connect with chariot-wheels in his imagination. (But see Macdonell and Keith, Vedic Index, vol. I, s.v. *pavi*, for a different interpretation).

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